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THE ECONOMIC IMPACT OF THE FEDERAL ENVIRONMENTAL PROGRAM: A REPORT TO THE SUBCOMMITTEE ON AGRICULTURE, ENVIRONMENTAL AND CONSUMER PROTECTION OF THE COMMITTEE ON APPROPRIATIONS OF THE HOUSE OF REPRESENTATIVES

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, D.C.

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CHAPTER I

INTRODUCTION AND SUMMARY

This report is submitted to the Subcommittee on Agriculture, Environmental and Consumer Protection of the House of Representatives Committee on Appropriations. The report was requested by the Committee in its Report on the Agriculture, Environmental and Consumer Protection Bill, 1975 (H.R. 15472). The request for this report stated:

> "Evidence before the Committee clearly indicates that the inflexibility of nationwide standards can and have played a role in creating energy shortages, inflation and unemployment. Testimony before the Committee indicates standards now being developed have the potential for costing hundreds of thousands of jobs, for significantly increasing prices for the consumer and for placing enormous demands on an already strained supply of investment capital. Common sense demands that all of these laws and regulations be reassessed in light of the precarious condition of our economy.
>
> "Therefore, the Committee directs the agency to thoroughly review all existing laws and regulations, as well as those now in the process of being developed. The Committee requires this information so that it can determine whether or not funds should be provided to implement these laws and regulations. Since most of this information is currently available within the agency, and will therefore only have to be brought together in a single report, the Committee will expect the report to be submitted no later than October 1, 1974."

A. Structure of the Report

The findings of this report result primarily from an assessment of economic and energy impacts of the following standards, regulations and programs:

- Effluent Limitation Guidelines, established under the Federal Water Pollution Control Act (FWPCA).
- New Source Performance Standards, established under the FWPCA.
- Thermal Limitations, established under the FWPCA.
- Municipal Construction Grant Program, established under the FWPCA.

- New Vehicle Federal Emissions Standards, established under the Clean Air Act (CAA).
- New Source Performance Standards, established under the CAA.
- Ambient Air Quality Standards, established under the CAA and implemented through State Implementation Plans (SIP's).

Economic and energy impacts in media other than air and water are also discussed; however, in many cases, the impact estimates for these programs (noise, radiation, solid waste, toxic substances, and pesticides) are incomplete and not well quantified because final Federal legislation has not been enacted or implementing regulations have not yet been promulgated. Until these regulations are fully developed, it is virtually impossible to estimate the associated economic and energy impacts with any precision. As EPA does perform economic impact analysis in the regulation formulation process in nearly all instances, data from these interim analyses have been included in this report.

For those sectors for which reliable data is available, this report assesses the following:

- Costs of meeting Federal regulations
- Macroeconomic impacts
- Impacts on specific industries
- Plant closings and production curtailments to date
- Impacts on food and fiber production
- Impacts on the automotive industry and automobile owners
- Impacts on individuals of various income classes
- Impacts on energy consumption and supply
- Further work being done to assess economic and energy impacts of EPA's programs.

The Committee advised that, in view of the short time available to carry out this work, this report should generally bring together information contained in available studies. Consequently, this report discusses a number of separate studies, some of which have been recently completed and some of which are as much as three years old. The major disadvantage of pulling together the results of disparate studies is that the studies cover varying time frames, have somewhat different assumptions, and have cost and energy estimates that may require updating. Thus, this summary report may not be as precise as desired. However, EPA has tried to insure consistency and compatibility in the development of this report.

A program of studies which will assess more precisely the economic and energy impact of EPA's standards and regulations is currently underway. This program, described more fully in Chapter XI, is scheduled for completion later this fiscal year.

Three additional limitations should be mentioned. First, most of the air and water cost estimates have been based on end-of-pipe treatment because that provides a basis for costing a standard treatment approach for a given type of plant. In many cases, however, less costly compliance can be attained through process changes which reduce the emissions, rather than through addition of equipment or mechanisms to capture the pollution. To the extent that less costly process changes are possible the costs presented here and consequently the economic impacts derived from those costs are overestimates.

Second, the energy estimates were developed assuming lower than current energy prices. Current higher prices provide a substantial incentive for industry to comply with pollution control regulations with an investment mix which is more capital-intensive and less energy consumptive than that used in EPA estimates. For this reason, some capital costs may be understated and energy demands may be overstated. And finally, no major improvements in current technology have been assumed. Such improvement could greatly reduce costs and/or energy consumption and thus reduce impacts below estimated levels.

B. National Standards

The Committee Report specifically suggests that a single nationwide standard may be unwise from an economic standpoint and unnecessary from an environmental standpoint. Considerable Congressional debate has centered around this issue, both before and since the 1970 and 1972 Amendments to the Air and Water Acts respectively. The previously established ambient air quality standards and water quality standards set general parameters for public health and safety with the intention that each State would devise its own method of achieving those parameters through a State Implementation Plan (SIP).

In the case of water quality standards , several major problems arose under pre-1972 legislation. Six different quality standards had been defined for water, depending upon the use for which the body of water was designated. Too often, determination of a use category by local government yielded a standard which was advantageous to industry and did not adequately protect the interests of the affected residents, leaving a widely varying system of standards. In fact there was the distinct possibility that States would compete with one another for location of industry through the setting of water use categories advantageous to industry. Also, significant problems arose in the case of two states bordering on the same body of water and each assigning it a different use category.

Finally, there was the general belief that many of the States lacked sufficient water quality monitoring data and capability to relate effluent discharges to ambient water quality or to enforce their own effluent standards. Therefore, though the States still have responsibility to achieve the overall water quality standards, Congress concluded in enactment of the 1972 Amendments that the setting of nationwide standards for point source discharge would be much simpler to implement.

Though it was recognized that some economic inefficiency might result, it was thought that a greater economic inefficiency would be eliminated and that more uniform and equitable requirements would be placed on industry with nationwide standards.

With respect to ambient air quality standards, the use of point source limitations is not as applicable as with water, since the ambient air quality is more regional in nature, depending upon mixing and dissipation of pollutants by air movements over large areas. For this reason the bulk of responsibility for meeting the air quality standards has been left in the hands of the States, to be accomplished through the State Implementation Plans (SIP's) which are subject to approval by EPA. However, for the prevention of competition among States for reasons stated above, Congress concluded that it was necessary to set national New Source Performance Standards (NSPS) for air emissions.

The other major air quality sector in which the Federal Government has set national standards is for mobile sources. The Committee Report specifically discusses the possible detriments of national rather than localized auto emissions standards. EPA feels strongly that it is infeasible to effectively implement the "two-car strategy" which is referenced in the Committee Report. This view is developed fully in Chapter VI.

The data presented in this report is an estimate of the economic and energy impacts expected from the nationwide standards which have been proposed or promulgated to date. They are not estimates of the difference in cost between national standards and local or State standards. A comparison of this nature is impossible because of the difficulty in estimating what localized standards would be, particularly in the face of a "fishable/swimmable" water quality goal for 1983. Moreover, there is no opportunity to observe for comparison sake, what localized standards would evolve, since most of the governing legislation prohibits any deviation from nationwide standards. Specifically:

- BPT and BAT standards under the Federal Water Pollution Control Act must be technology-based standards limited by what the industry involved can afford, but not by any EPA determination of what is needed. Consequently, EPA can set less expensive standards for sectors of an industry which for some reason (age, process, geography) cannot meet the standards imposed on other sectors (standards for more than 200 subcategories have been included in the first 30 industry regulations promulgated under the FWPCA); but EPA cannot tailor the standards to environmental need. In fact, plant-by-plant standard determination is prohibited by the law, except where State water quality standards dictate more (not less) control.
- New Source Performance Standards (NSPS) under both the air and water legislation are specifically limited to the most stringent level of control demonstrated to be economically feasible.
- Passenger car emission standards are determined by the Clean Air Act. EPA has no discretion concerning them beyond the decision as to whether or not to grant one-year suspensions on new levels of control. EPA has discretion on all other mobile source emission standards.
- Ambient air quality standards set under the Clean Air Act must be national standards. They are to be based solely on the atmospheric concentration of pollutants at which damages to health or welfare occur.

EPA has accomplished one study which assesses the costs of not having control over local standards. In reviewing the availability of low sulfur fuel and sulfur oxide control technology, EPA learned that States which set sulfur oxide emissions limits more stringent than needed to meet the national primary air quality standards have created an excess demand of about 185 million tons of low sulfur coal. This "overkill", unless eliminated by the States, will delay the attainment of the primary standards, to the extent that fuel-burning sources in clean areas bid away low sulfur fuel from other sources which need it to meet the primary standard. EPA is trying to get the States involved to delay or eliminate the "overkill" portion of their regulations, and roughly 25% of this problem has been eliminated.

C. Economics and Energy in the EPA Standard-Setting Process

It is now EPA policy to require an economic and energy impact assessment as part of the development of each major standard. Where appropriate, these assessments are incorporated into the standard-setting process; but in many cases (as detailed in the previous section), the use of economic and energy considerations are limited by the governing legislation. In such cases EPA feels that it must, as a responsible government agency, be aware of the economic and energy impacts, even if those data are not allowed to influence the standard-setting process.

The specific mechanism for accomplishing the assessment of both the economic and energy impacts of proposed standards and regulations is defined in EPA Order No. 1000.6. This order requires that an economic and energy review will be accomplished through working group review and through review of the proposed standards by the Agency's Steering Committee for Standards and Regulations.

D. Major Findings of the Report

Subsequent chapters of this report discuss in detail the economic and energy impacts associated with EPA's major standards, regulations, and programs. The following summarizes the major points addressed, and the principal findings associated with each.

Economic Impacts

Total Costs. The combined capital costs and operating and maintenance costs required to meet Federal environmental regulations over the decade 1973-1982 are estimated to be $194.8 billion. This figure includes about $133 billion for air pollution control and about $51 billion for water pollution control. Approximately $81 billion in capital for pollution control facilities and equipment will be required during this period.

Costs - Air. By major area, the costs for air pollution control are divided (using 1979 as a sample year) among mobile sources (44%), fossil fuel combustion (36%), and industrial processes (20%). As a percentage of total capital expenditures, mobile source control (primarily emissions controls for automobiles) will increase in the second half of the decade to 60% of the annual total. The industries (other than automotive) which will be required to make the largest investment (as a percent of the total pollution control investment required) are steam electric power (16%), iron and steel (4.3%), feed mills (2.9%), and primary aluminum (2.2%).

Costs - Water. From $5.3 billion to $7.1 billion in capital investment will be required to meet the first 30 1977 Effluent Guideline regulations for specific industries. By industry, the largest expenditures (as a percent of total estimated capital requirements) are projected for chemicals and allied products (15%), primary metals (11%), paper and allied products (11%), petroleum refining and related industries (11%), and food and kindred products (9%).

Inflation. The study completed by Chase Econometrics in 1973 indicates that increased inflation (as measured by the implicit GNP deflator) resulting from all pollution control programs will average about 0.2% per annum for the period 1972-1980. The entire environmental program is estimated to have been responsible for less than 0.5% of the 17% increase in the Wholesale Price Index which occurred during the year ending in March 1974.

GNP. The Chase Econometrics Study of 1973 also shows that as a direct result of pollution control programs, constant dollar GNP would be $6.5 billion lower in 1973, $5.8 billion lower in 1977, and $15 billion lower in 1980 than it would have otherwise been. These impacts average out to a decline in the estimated annual GNP growth rate of about 0.1% through 1980.

Employment. Over the period 1972 through 1980, the Chase Econometrics Study projects unemployment to increase at an average annual increment of 0.1% as a direct result of pollution control programs. EPA is currently aware of 12,000 job losses which have allegedly occurred as a result of pollution control requirements, and most of these have been associated with enforcement of State and local regulations rather than Federal regulations. The plants which have threatened to close under existing and proposed Federal regulations could account for another 44,000 workers. Eighty-one percent of these jobs are concentrated in the pulp and paper, primary metals, and chemicals industies. The single industry which could be most affected in terms of unemployment is the steel industry. EPA currently has underway a special study to determine the extent of potential adverse economic impact in that industry.

Plant Closures. Since January 1971, EPA has learned of 69 plant closings for which pollution control was alleged to be a significant factor, but only 14 of these closings involved any Federal enforcement. EPA has learned through its Economic Dislocation Early Warning System that 81 plants are threatened with closure as a result of existing environmental regulations. However, in most of these cases the plants appear to be marginal operations, unlikely to survive even in the absence of environmental requirements. Longer term projections for the decade 1973 through 1982 indicate 300 to 500 possible plant closures from the 1977 requirements for Best Practicable Control Technology Currently Available (BPCTCA). This forecast may be high to the extent that plants can adopt process changes which are less expensive than the end-of-pipe treatment assumed in the EPA studies.

Capital Availability. Research by EPA and the Council on Environmental Quality has indicated that the total capital requirements for pollution control, including compliance with both State and Federal regulations, over the next decade are expected to equal 2-3% of gross private domestic investment and about 6% of private investment in plant and equipment. As such, these investments should not significantly effect the availability of capital. However, EPA currently has underway a major study on capital availability to insure that it has a comprehensive assessment of this impact.

Agriculture. Restrictions to date on the use of pesticide products have had only minimal impacts on food and fiber production. For the vast majority of cancelled uses, alternative pest control methods have been available, and the initiation of scouting programs and the use of integrated pest management techniques may defray costs associated with use of more expensive alternatives. A recent study by the U.S. Department of Agriculture estimates that the costs due to suspension of aldrin and dieldrin (assuming the unavailability of heptachlor and chlordane) on corn production are at most $25 million based on 1971 production data and an assumed loss of 0.4% in yield. The actual costs of that suspension may be much less than $25 million due to savings to farmers from elimination of uneconomic uses. Effluent limitations on the fertilizer industry may be somewhat more significant, though the exact magnitude of impact has not yet been determined. Estimates for loss in phosphate fertilizer production range between 5% and 22%, though the high end of the range is unlikely and closures which may result would probably include some outdated plants which can no longer compete with modern technology.

Automobiles. The auto industry has expended $2 billion for emissions control development. 1975 auto prices will include approximately $165 more of pollution control costs than do 1974 models; however, better gasoline mileage and lower resulting maintenance costs will more than offset the increased purchase price.

Net Foreign Balance. The 1973 Chase Econometrics Study indicates that as a direct result of compliance with both State and Federal pollution control requirements, the net foreign balance position of the U.S. is estimated to be $3.8 billion worse in 1976 and $1.1 billion worse in 1980.

Energy Impacts

Total Energy Impacts. The energy impact of EPA regulations and programs is estimated to be about the equivalent of 525,000 barrels of oil per day (525 MBD) in 1980, or about 1.1% of forecasted total national consumption of energy. A summary of these energy impacts is shown in Table I-1. To facilitate comparisons, all energy is reported in units of thousands of barrels of crude oil per day, regardless of the fuel source. Energy savings are presented in parentheses.

TABLE I-1
SUMMARY OF ENERGY IMPACTS OF EPA'S PROGRAM IN 1980

Air Programs	(Thousands of bbls per day)	
Electric Power Plants	145	
All other	125	
Stationary Sources (Subtotal)		270
Auto Emission Controls	160	
Lead Free Regulations	60	
Low Lead Regulations	35	
Transportation Controls	(135)	
Mobile Sources (Subtotal)		120
Water Programs		
Municipal Wastewater		45
Electric Power Plant	50	
All other	40	
Industrial Effluent Guidelines (Subtotal)		90
Solid Waste Programs*		
Combustion of Solid Waste	(65)	
Recycling of Materials	(35)	
TOTAL ALL EPA PROGRAMS		525

( ) reprsent positive impacts.

* Energy benefits from solid waste programs have not been included in the total above because they primarily result indirectly from EPA's research and educational programs rather than from direct regulations. If included, this potential energy savings of 100 MBD would result in a net energy penalty of 425 MBD.

We believe these estimates are conservative--i.e., for the most part they are close to the upper bound of the range of estimates which EPA and outside consultants have calculated. The following paragraphs discuss in more detail the energy impacts shown on the summary table.

Energy Impacts on Stationary Sources. Steam electric power plants are estimated to incur total energy requirements of up to the equivalent of 145,000 barrels per day of crude oil (145 MBD) to meet air quality standards. Flue gas desulfurization in 1980 is estimated to require up to 110 MBD of crude oil if scrubbers are installed on 90,000 MW of coal-fired capacity (20% of total fossil-fuel fired capacity). Scrubbers are either being installed or are planned for at least 35,000 MW of capacity at this time. Other requirements, such as particulate removal and desulfurization of fuel oils, are estimated at about 15 MBD and 20 MBD of crude oil respectively.

All other industries are estimated to require about 80 MBD to meet air quality standards. Of this, 25 MBD would be due to new source performance standards for specific emissions, and 55 MBD is due to desulfurization of fuel oil in order to comply with State Implementation Plans.

The residential and commercial sectors of the economy are estimated to require 45 MBD for desulfurization of fuel oil to comply with these State Implementation Plans. Almost all of these regulations have been in effect for several years.

Mobile Source Energy Requirements to Comply with Statutory Standards. Current data indicates that 1975 model year automobiles will be substantially more efficient than 1974 autos, and at least as efficient as autos built before any emission controls were installed (i.e., pre-1968). Future emission control systems should not degrade engine efficiency below 1975 levels. This was reached in a joint DOT-EPA Report to Congress on October 24, 1974. Furthermore, the DOT-EPA Report predicted that by 1980 autos could average between 15 and 27 mpg, depending on vehicle weight.

In 1973, the total fuel penalty due to emission controls for all cars on the road totalled 270 MBD. This energy penalty is expected to decline to 160 MBD in 1980 as cars currently in use are gradually phased out.

These estimates assume that future controls will be applied to autos with the same weights, engine sizes, and sales mix as autos sold during 1973. In reality, both the technology and sales mix of automobiles are changing very rapidly, and the changes taking place tend to improve fuel economy beyond that assumed in this study.

It should be noted that the joint EPA-DOT study on fuel economy stated that "achievement of the statutory emission standards for hydrocarbons and carbon monoxide with substantial fuel economy improvement is feasible in the new car fleet of 1980 compared to 1974." However, the study was unable to determine the amount of the fuel economy impact associated with meeting the statutory nitrogen oxide standard. The fuel economy penalties due to emission controls which have been computed in this paper assume that the statutory NOx standard is met in 1978, and that technologies to meet it which have been recently developed will be available in 1978 in sufficient quantities such that no fuel penalty results.

EPA's lead regulations affect energy use by changing the mix of products which any given refinery can produce. The refinery compensates by operating some equipment more intensively. This requires additional energy. Consultants for EPA estimate that this penalty in 1980 will be no greater than 95 MBD. As new equipment is installed, this penalty should decrease substantially.

Because new autos with catalysts require lead-free gasoline, and because it becomes less economic to manufacture gasoline without lead at octanes over 91 (RON), many engines were redesigned in order to operate efficiently on 91 octane gasoline. This reduction in engine compression ratios caused a loss of operating efficiency of about 3%. This loss, equivalent to about 95 MBD in 1974, and 50 MBD in 1980, is included in the penalty under auto emission controls.

EPA's transportation control programs are designed to reduce pollution to meet standards in certain urban areas where stationary and mobile source regulations by themselves cannot meet these national goals. Since most transportation control plans result in reduced energy consumption, they provide substantial energy benefits. These benefits are tentatively estimated to be about 105 MBD by 1980. Vapor recovery programs at service stations should yield an additional 30 MBD savings.

Energy Requirements for Water Pollution Control. The estimated total energy demand for municipal wastewater treatment plants is about 45 MBD in 1980. Sewage plants presently consume about 20 MBD. This estimate assumes that the 1977 goal of best practicable treatment is met in 1978, that incineration of sludge does not become the primary method of waste disposal, and that methane produced during the treatment process is not recovered or used for fuel.

Sewage treatment energy requirements are sensitive to assumptions about the degree of advanced waste treatment required to meet water quality standards. These estimates do not include energy required in the manufacturing of chemicals. Some forms of intensive or advanced treatment could require energy for chemical manufacturing which would be in excess of these estimates.

Electrical power plants require control systems to reduce chemical effluents and to cool the temperature of their discharge. Recent analyses have estimated that control of chemical discharge requires negligible amounts of energy, but that cooling of thermal discharges will require the equivalent of 50 MBD as an energy penalty in 1980.

Detailed estimates of the energy penalties associated with water effluent guidelines for other industries have not been completed, but preliminary estimates indicate that the 1980 penalty would be about 40 MBD.

Energy Benefits from Solid Waste Recovery. Projections of the energy which can be reclaimed from municipal waste and garbage and used as fuel in power plants indicate that at least the equivalent of 65 MBD can be saved by 1980. This estimate is based on 1973 fuel prices. Current higher fuel prices are expected to accelerate construction of power generation facilities which depend in part on the use of municipal garbage.

Recycling of material will conserve energy by reducing the amount of energy required in the manufacture of certain products -- e.g., steel, aluminum, and glass. Our estimate is that about 35 MBD can be saved in 1980 by this approach.

No estimate is available regarding the amount of recycling or solid waste combustion which can be attributed directly to EPA's program efforts. It is expected that a substantial proportion of this activity might occur regardless of EPA's effort.

E. Further Research

In a continuing effort to provide more comprehensive and accurate analysis of the economic and energy impacts from pollution control regulations, the following studies have been undertaken by EPA and are scheduled for completion in this fiscal year:

- A fourth annual iteration of the Chase Econometrics model, using an expanded and updated data base to estimate macroeconomic impacts for several scenarios of regulation timing and economic conditions.
- Individual studies of the combined economic impact of all environmental regulations on six of the most heavily impacted industries:
    - Steel
    - Electric Utilities
    - Petroleum
    - Chemicals
    - Pulp and Paper
    - Nonferrous Metals
- A study of the combined impact of all pollution control regulations on the cost and availability of investment capital.
- Supporting analysis for the National Academy of Sciences study on the energy implications of the Federal pollution control regulatory program.

These studies, together with the continuing series of economic impact analyses of proposed regulations on individual industries, will provide the comprehensive and coordinated analysis of economic and energy impacts which is needed and which is not currently available from existing data.

CHAPTER II

COSTS OF POLLUTION CONTROL

This chapter presents available information on the costs of pollution control. Costs are limited where possible to the projected costs of control resulting from Federal legislation, thus excluding the costs of common industry practice or of local and State legislation not provided for by Federal legislation. These costs tend to be high estimates in that they generally are based on assumptions that pollution control equipment will be installed, whereas process changes in some cases will be less costly. These estimates are low estimates to the extent that they do not include the costs of regulations not yet promulgated and to the extent that they exclude indirect or secondary cost effects.

Information on the costs of Federal pollution control is accumulated by the Council on Environmental Quality (CEQ) for publication in its annual report. More detail is provided on air costs from the 1974 EPA Report to Congress on The Cost of Clean Air. More detail is provided on water costs from the 1973 EPA Report to Congress on The Economics of Clean Water and from the studies completed in the last year in support of the development of effluent guideline limitations governing industrial water pollution.

There is less detailed information to report on the costs of environmental programs other than those protecting the air and water. The estimates for solid waste, noise, radiation, pesticides, toxic substances, and land reclamation programs are less complete for a variety of reasons, including lack of final Federal legislation or standards in these areas and incomplete data. Consequently discussion of these costs is necessarily limited.

In addition to the projections of costs of meeting pollution control regulations, this chapter also gives data from the Bureau of Economic Analysis survey of industrial pollution control expenditures. These data on what industry says it is spending provide a useful supplement to the EPA and CEQ estimates of what resources will be spent for pollution control.

A. Total Pollution Control Costs

The costs of pollution control for the decade 1973-1982 as presented below are drawn from CEQ's best estimate of costs which result from Federal environmental legislation. They are incremental costs, to be made in compliance with Federal legislation, beyond those expenditures which would have been made in the absence of such legislation. These cost projections will be published in the forthcoming 1974 CEQ Annual Report and are presented here with permission of CEQ.

Nearly all of the \$194.8 billion of costs projected for the decade will be to control pollution of the air (\$133.3 billion) and water (\$51.0 billion). EPA construction grants to municipalities are included under the State and local category of water pollution control costs in Table II-1.

The total capital requirements for the decade are reported by CEQ as \$81.4 billion (excluding noise control), of which \$62.1 billion represent private sector requirements.

Table II-1

ESTIMATED INCREMENTAL POLLUTION CONTROL EXPENDITURES[1]

II-2-a

[In billions of 1973 dollars]

Pollutant/medium	1973 O & M[2]	1973 Capital costs[3]	1973 Total annual costs[4]	1982 O & M[2]	1982 Capital costs[3]	1982 Total annual costs[4]	Cumulative - 1973-82 Capital invest-ment	Cumulative - 1973-82 O & M[2]	Cumulative - 1973-82 Total annual costs[4]
Air pollution									
Public	.1	.1	.2	.5	.2	.7	1.7	3.8	5.4
Private									
Mobile	1.2	.2	1.4	8.4	4.9	13.3	31.3	49.9	74.4
Industrial	.5	.7	1.2	1.3	1.1	2.4	8.4	11.6	24.5
Utilities[7]	.5	.3	.8	2.7	1.2	4.0	7.9	19.6	29.0
Total	2.3	1.3	3.6	12.9	7.4	20.4	49.3	84.9	133.3
Water pollution									
Public									
Federal	.2	NA	NA	.2	NA	NA	1.8	NA	NA
State and local	1.1	.1	1.1	1.4	1.3	2.7	14.8	12.8	24.4
Private									
Industrial	.5	.5	1.0	1.5	1.2	2.6	9.8	12.3	23.1
Utilities[7]	0	0	.01	.4	.3	.7	4.4	2.2	3.5
Total	1.8	.6	2.1	3.5	2.8	6.0	30.8	27.3	51.0
Radiation									
Nuclear powerplants	NA	NA	NA	.05	.05	.07	.3	.08	.3
Solid waste									
Public	.1	.1	.2	.3	.1	.4	1.0	2.2	2.9
Private	.1	<.05	.1	.5	<.05	.5	< .05	2.3	2.3
Total	.2	.1	.3	.8	.1	.9	1.0	4.5	5.2
Land reclamation[5]									
Surface mining	.3	0	.3	1.6	0	.6	0	5.0	5.0
Noise[6]	NA	.1	NA	NA	1.0-1.4	NA	6.0-8.7	NA	NA
Grand total[6]	4.6	2.0	6.3	18.8	10.4	28.0	81.4	121.8	194.8

Notes:

1. Incremental costs are expenditures made pursuant to Federal environmental legislation, beyond those that would have been made in the absence of this legislation.
2. Operating and maintenance costs.
3. Interest and depreciation.
4. O&M plus capital costs.
5. Only includes coal mining.
6. Noise abatement costs not included in grant total.
7. Includes expenditures by public sector owned utilities (such as TVA).

B. Air Pollution Control Costs

The costs of air pollution control are reported annually to Congress in The Cost of Clean Air. The costs in this section are taken from the 1974 report.

EPA has estimated that $47.3 billion (1973 dollars) in incremental capital investment expenditures will be required during the 1971-79 period in order to comply with the Clean Air Act. These figures represent those costs which will directly result from compliance with the Act. Table II-2 summarizes the estimated investment expenditures for the decade and the annualized costs in FY 1979 for each sector. By major area the costs are:

	Cumulative Investment					
	1971		1975-79		Annual Costs for 1979	
	$ Billions	%	$ Billion	%	$ Billion	%
Mobile Sources	23.1	49	19.8	60	7.4	44
Fossil Fuel Combustion	13.0	27	6.7	20	6.1	36
Industrial Processes	11.2	24	6.3	20	3.4	20
TOTAL	47.3		32.8		18.9	

As a percentage of total capital expenditures, mobile source control will increase in the second half of the decade to 60% of the annual total. This is in response to compliance with the statutory standards for HC and CO in 1977 and NOx in 1978, and the figures used include the cost of pollution control equipment actually installed on new production automobiles. After mobile source control, the industries which will be required to make the largest investments are steam electric power (16%), iron and steel (4.3%), feed mills (2.9%), and primary aluminum (2.2%).

TABLE II-2

INCREMENTAL NATIONAL COSTS FOR AIR POLLUTION ABATEMENT FROM FY 1971 THROUGH FY 1979 (millions of dollars)

	Cumulative Investment			Annualized Costs (FY 1979)[a]		
	Expected	Minimum	Maximum	Expected	Minimum	Maximum
Mobile Sources						
Sub-Total	23,107.0	23,107.0	23,107.0	7,382.0[b]	7,382.0[b]	7,382.0[b]
Fossil Fuels						
Steam Electric Power	7,460.0	5,990.0	9,310.0	4,630.0	3,450.0	5,530.0
Commercial and Industrial	5,534.0	3,433.0	7,186.0	1,479.0	667.0	2,212.0
Sub Total: Fossil Fuels	12,994.0	9,423.0	16,496.0	6,109.0	4,117.0	7,742.0
Fuel Industries Group						
Coal Cleaning	15.8	14.5	17.2	3.3	3.1	3.6
Natural Gas Processing	90.0	79.0	105.0	27.3	23.9	30.9
Petroleum Industry	850.0	716.0	993.0	240.8	170.4	302.0
Chemical Industries Group						
Carbon Black	-	-	-	-	-	-
Chlor-Alkali	16.7	15.2	18.4	6.4	6.0	6.8
Nitric Acid	35.4	28.6	42.0	14.2	12.8	15.9
Phosphate Fertilizer	19.4	16.8	21.7	9.8	8.9	10.6
Sulfuric Acid	407.2	366.4	457.1	105.6	96.2	114.3
Metals Industries Group						
Ferroalloy	74.3	70.8	77.9	29.4	28.4	30.7
Foundries(Iron)	339.0	241.0	422.0	180.0	149.0	234.0
Foundries(Steel)	77.2	70.9	83.6	25.5	24.1	27.0
Iron and Steel	2,039.0	1,963.0	2,113.0	687.9	667.9	708.2
Primary Aluminum	1,047.0	998.0	1,098.0	424.0	411.0	438.0
Primary Beryllium	-	-	-	-	-	-
Primary Copper	491.0	449.0	539.0	147.0	138.0	156.0
Primary Lead	27.3	16.8	38.6	6.8	4.1	9.5
Primary Mercury	.9	.8	.9	.2	.2	.3
Primary Zinc	32.4	27.3	39.6	8.2	6.9	10.0
Secondary Aluminum	18.5	15.6	23.4	5.7	4.9	6.8
Secondary Brass and Bronze	9.5	7.2	12.8	3.8	2.9	5.0
Secondary Lead	10.8	6.4	15.1	2.5	1.2	3.8
Secondary Zinc	2.1	1.2	2.9	.7	.4	.9
Burning and Incineration Group						
Dry Cleaning	144.0	120.2	170.3	12.1	6.7	17.9
Sewage Sludge Incineration	62.7	54.5	70.7	15.5	13.7	17.4
Solid Waste Disposal	1,638.0	1,520.0	1,880.0	694.0	619.0	766.0
Teepee Incinerators	-	-	-	-	-	-
Uncontrolled Burning						
Agricultural	-	-	-	-	-	-
Coal Refuse	-	-	-	-	-	-
Forest Fires	-	-	-	-	-	-
Structural Fires	-	-	-	-	-	-
Quarrying and Construction Group						
Asbestos Industry	11.3	10.4	12.9	3.9	3.3	4.3
Asphalt Concrete Industry	604.0	401.0	828.0	119.0	89.0	155.0
Cement Industry	444.0	364.0	526.0	129.0	113.0	144.0
Crushed Stone, Gravel, Sand	-	-	-	-	-	-
Lime Manufacturing	60.8	52.1	68.9	13.3	12.0	14.9
Food and Forest Products Group						
Feed Mills	1,377.0	1,228.0	1.537.0	255.0	231.0	281.0
Grain Handling	985.0	827.0	1,111.0	149.0	125.0	170.0
Kraft Paper	234.0	201.0	272.0	78.0	70.0	92.1
Semichemical Paper	26.7	22.7	31.2	12.3	10.5	14.5
Sub Total: Industrial Sources	11,191.0	9,895.4	12,629.2	3,410.2	3,053.3	3,791.4
TOTAL	47,292.0	42,425.4	52.232.2	16,901.2	14,552.3	18,915.4

(a) Estimated on the basis that all the required capital investment has been made as in FY 1979.

(b) The annualized cost for Mobile Sources for the year FY 1979 is that estimated actually to occur in FY 1979. This annualized cost includes estimated operating and maintenance expenses for light and heavy-duty vehicles, plus an estimated $1,085 billion for the cost of implementing in transportation control plan.

SOURCE: The Cost of Clean Air - 1974, p. I-3

C. Water Pollution Control Costs

Table II-1 projects $66.2 billion in expenditures for water pollution control in the decade 1973-1982, composed of $24.1 billion of public expenditures and $42.1 billion of private expenditures. The estimate of private expenditures for industrial water polution control is based in part on data presented in the December 1973 Economics of Clean Water Report to Congress and on data from the studies completed in the last year in support of effluent guideline development.

The 1973 Economics of Clean Water report estimates that an additional $11.9 billion in capital would be required to meet 1977 effluent standards (excluding electric utilities), as shown in Table II-3. Forty percent of that expenditure is expected to be in new plants. By 1977, the increased annual expenditures due to compliance with water regulations were estimated at $4.54 billion. The largest expenditures were projected in the following five industry groups.

	CAPITAL EXPENDITURES ($ Millions)	% OF TOTAL
Chemicals and Allied Products	$2,761	15
Primary Metals	2,133	11
Paper & Allied Products	2,006	11
Petroleum Refining and Related Industries	1,991	11
Food and Kindred Products	1.718	9

The right-hand column shows the percentage of total industrial water pollution control investment accounted for by each industry.

11-4-a

TABLE II-3

COSTS FOR EXISTING AND PROJECTED PLANTS TO MEET 1977 EFFLUENT STANDARDS (Scenario No. 3)*

SIC code no.	Industry	Total capital needed by 1977	Total O&M costs	Total annual costs	Capital in place 1972	Total capital to be added by 1977	Average capital expenditures needed per year	Capital expenditures 1972†	1972 expenditures as % of average annual needs
		(millions of 1972 dollars)							
02	Animal feedlots	1,274	113	247	459	815	204	n.a.	n.a.
20	Food and kindred products	1,718	503	721	325	1,393	348	68	20
22	Textile mill products	860	181	290	74	786	196	10	5
24	Lumber and wood products	1,123	399	541	n.a.	n.a.	n.a.	n.a.	n.a.
26	Paper and allied products	2,006	237	492	597	1,409	352	149	42
28	Chemicals and allied products	2,761	234	585	1,194	1,567	392	214	55
29	Petroleum refining and related industries	1,991	209	290	892	1,099	275	189	69
30	Rubber and miscellaneous plastic products	441	167	223	86	355	89	31	35
31	Leather and leather products	259	53	85	n.a.	n.a.	n.a.	n.a.	n.a.
32	Stone, clay, glass, and concrete products	1,269	26	187	146	1,123	281	43	15
33	Primary metals	2,133	90	361	763	1,370	342	119	35
34	Fabricated metal products	994	56	182	392	602	105	42	40
35	Nonelectrical machinery	774	50	149	171	603	151	53	35
36	Electrical and electronic machinery	631	28	108	159	472	118	36	31
37	Transportation equipment	491	17	79	211	280	70	62	89
	Total	18,725	2,363	4,540	5,469	11,874	2,923	1,016	33

*Including capital needed for treatment facilities at new plants as well as at existing plants.
†Based on *Annual McGraw-Hill Survey of Pollution Control Expenditures*, 5th and 6th editions.

SOURCE: The Economics of Clean Water - 1973, p. 42

More recent information indicates that capital investment of $5.3 to $7.1 billion will be required to meet the first 30 1977 guidelines issued for specific industries. The costs are tabulated by industry in Table IV-2. These figures are based on 30 separate economic impact studies conducted by the Agency in the process of establishing effluent guidelines for these industries. For steam electric plants the BPT (1977) costs include only chemical costs, whereas most of the total $4.1 billion costs for the industry, including thermal costs, are required to meet BAT standards. They do not represent the total costs of the effluent guidelines because more regulations will be promulgated, including guidelines for portions of industries which were only partially covered in the first 30.

D. Cost of Solid Waste Management

Costs of Federal regulation of solid waste management are very small since EPA has authority to regulate non-Federally owned solid waste facilities only with respect to air emissions from incineration of solid wastes and the disposal of pesticides and pesticide containers. Guidelines have been promulgated regulating thermal processing and land disposal for Federal government wastes. Emissions from incinerators are controlled by State Implementation Plans under the Clean Air Act and these costs are reported in Table II-1.

/

E. Costs of Pesticide Regulations

To date, EPA has cancelled or suspended three pesticides of major agricultural significance: DDT, aldrin, and dieldrin. In addition, EPA has issued a Notice of Intent to cancel heptachlor and chlordane.

There is no reliable national cost estimate available for the cancellation of DDT. The economic impacts of the DDT decision on agricultural costs, production and prices for major and minor uses are currently being reviewed to obtain a better indication of the impacts than were available in the hearing record at the time of the Administrator's decision in June 1972. The record developed during the DDT hearings was limited as to specific costs of alternative controls as they would actually occur in 1973. Indications are that impacts upon cotton and other sectors have not been severe. Final results of this review are expected to be available no later than June 1975.

A recent study by the U.S. Department of Agriculture (USDA) estimates that the costs for corn production of the suspension of aldrin and dieldrin (assuming the unavailability of heptachlor and chlordane) are about $25 million, based on 1971 production data and an assumed loss of 0.4% in yield.

These figures represent a combination of the added costs for corn production from the use of more expensive alternative pesticides and the value of reduced per-acre yields. Administrative Law Judge Herbert Perlman said in his September 20, 1974, decision recommending final suspension of aldrin and dieldrin that the USDA assumption might be an overestimate, in part because of savings to farmers from elimination of uneconomic use of these pesticides.

The cost of cancellation of heptachlor and chlordane is expected to be small because of the availability of alternatives and because the time frame of the cancellation proceedings will allow planning for the increased use of alternatives. No use of these pesticides will be cancelled until completion of a public hearing, unless EPA, USDA, and the registrant all agree to the action. Though overall costs are expected to be negligible, some effects are possible in specific locales, particularly for corn production on land subject to black cutworm infestation and for citrus and strawberry production.

Other costs resulting from EPA's regulatory program which are not assessed here included the costs of registration, applicator certification, and experimental use permits.

F. Noise Control Costs

At the present time only one EPA noise regulation has been finally promulgated. Consequently, it is difficult to estimate future control costs for noise.

Thus far regulations have been promulgated only for interstate motor carries, and they have been proposed for interstate rail carriers, for new medium and heavy duty trucks, and for portable air compressors. Cost estimates for these regulations are shown in Table II-4.

TABLE II-4

PRELIMINARY ESTIMATES OF NOISE CONTROL COSTS
IN MILLIONS OF 1974 DOLLARS

Regulation	1975	1976	1977	1978	1979
Interstate Motor Carrier[1/]	10				
Interstate Rail Carrier[2/]				50	50
Medium & Heavy Duty Trucks[2/]			45*	48*	50*
Portable Air Compressor[2/]		20	20	20	20

1/ EPA Regulation Promulgated

2/ EPA Regulation Proposed

* Excludes Fan Clutch Savings and assumes an annual rate of 5%.

SOURCE: EPA Office of Noise Abatement and Control

G. Reported Expenditures for Pollution Control

The above projections have estimated the cost of meeting Federal environmental regulations. Until very recently there were no reliable data on how much is actually spent by industry on pollution control. In the July 1974 Survey of Current Business, however, the Department of Commerce Bureau of Economic Analysis reported on its recent survey of industrial pollution control expenditures.

Table II-5 shows the results of that study. Businesses claimed pollution control expenditures for 1973 at the rate of $4.9 billion for the year, with expenditures for 1974 projected at the rate of $6.5 billion for the year. The survey estimated capital expenditures of $1.2 billion for 1973, with $1.5 billion planned for 1974. One of the most significant findings of the study was that only 2% of the firms surveyed reported that pollution abatement requirements caused a reduction in other capital spending.

TABLE II-5

CAPITAL EXPENDITURES BY U.S. BUSINESS FOR THE ABATEMENT OF AIR AND WATER POLLUTION1/, ESTIMATED 1973 AND PLANNED 1974

	Expenditures for new plant and equipment (million of dollars)							
	1973				1974			
	Total*	Pollution Abatement			Total2/	Pollution Abatement		
		Total	Air	Water		Total	Air	Water
All industries	100,076	4,938	3,176	1,762	112,114	6,543	4,346	2,196
Manufacturing	38,003	3,153	2,050	1,103	44,404	4,446	2,929	1,517
Durable goods3/	19,389	1,579	1,207	372	22,611	2,063	1,523	540
Primary metals 3/	3,481	814	712	101	4,337	1,003	841	163
Blast furnace, steel works	1,407	230	163	67	1,712	381	304	78
Nonferrous	1,679	523	492	31	2,156	553	469	83
Electrical machinery .	2,895	129	44	85	3,179	175	53	122
Machinery, except electrical	3,478	80	52	28	3,975	118	74	44
Transportation equipment	3,063	170	96	74	3,570	195	112	83
Motor vehicles	2,244	143	81	62	2,682	178	103	75
Aircraft	531	20	11	10	580	13	7	6
Stone, clay & glass ..	1,503	144	123	22	1,683	282	244	39
Other durables3/	4,969	243	180	63	5,867	290	200	90
Nondurable goods3/	18,614	1,574	843	731	21,793	2,383	1,406	977
Food including beverage	3,048	152	68	84	3,276	230	112	118
Textile	787	29	9	20	773	43	17	26
Paper	1,893	355	174	181	2,484	500	326	174
Chemical	4,324	416	203	213	5,249	608	293	316
Petroleum	5,409	555	352	203	6,888	926	610	316
Rubber	1,567	48	26	23	1,580	51	33	18
Other nondurables3/ ..	1,586	19	12	7	1,543	24	16	9
Nonmanufacturing	62,073	1,785	1,126	659	67,710	2,097	1,418	679
Mining	2,759	91	41	50	3,143	100	53	47
Railroad...............	1,939	16	5	11	2,272	19	3	16
Air transportation	2,413	15	12	4	2,160	9	4	5
Other transportation ..	1,605	11	6	5	1,617	17	10	7
Public utilities	19,087	1,451	921	530	22,163	1,696	1,179	518
Electric	16,250	1,409	906	503	18,808	1,651	1,160	491
Gas and other	2,837	42	15	27	3,355	46	19	27
Communication, commercial, and others 4/	34,270	201	142	58	36,355	256	170	87

*Preliminary

1/ Date exclude expenditures of agricultural business and outlays charged to current account.

2/ Estimates are based on expected capital expenditures reported by business in late November and December 1973. The estimates for 1974 have been adjusted when necessary for systematic biases in expectational data.

3/ Includes industries not shown separately.

4/ Includes trade, service, construction, finance, and insurance.

NOTE: Details may not add to totals because of rounding.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis.

CHAPTER III

MACROECONOMIC IMPACT OF POLLUTION CONTROL

The impact of the costs of pollution control on the economy can be assessed at two different levels. This chapter will discuss the macroeconomic impact of these costs, such as the impacts on GNP, inflation, and employment at the national level. Chapters IV and V will show the impact of these costs at the microeconomic level, that is on particular firms, industries, or sectors of the economy.

Several distinctions should be made between the macro and micro level impacts. The micro level assessment can highlight the effects on individual portions of the economy which are particularly impacted by pollution control costs. The macro level assessment shows the aggregate impact on the entire economy, combining the impacts on industries or sectors with high pollution control costs with the negligible impacts on portions of the economy with no pollution control costs. The macroeconomic assessment brings into the analysis the positive effects of pollution control, such as the jobs created to build and operate pollution control equipment, which are implicitly balanced off against the jobs lost because of higher prices for goods produced in processes requiring pollution control expenditures. Also, by looking at the aggregate impact across all firms and sectors of the economy, the macroeconomic analysis tends to average out impacts that are highlighted in microeconomic analyses. For instance, an industry impact study may focus on the number of workers unemployed as a result of plant shutdowns caused by pollution control; but if the production of these closed plants is compensated for by increased production levels at other plants, then the macroeconomic study would show little or no employment and production impact.

Hence, the macro and micro level studies tend to focus on different aspects of pollution control impacts. It is important to realize, however, that neither macro nor microeconomic impact studies show the positive economic effects of eliminating pollution control damages, as measured by reduced health care costs, increased crop yields, higher recreational and aesthetic values, or reduced damages to materials.

A. 1971-72 Macroeconomic Studies

EPA has sponsored three different studies of the macroeconomic impacts of its program. The first was jointly funded in 1971-72 by EPA, the Council on Environmental Quality (CEQ), and the Department of Commerce. Estimated costs for pollution control were used as inputs to the Chase Econometrics Associates macroeconomic model of the U.S. economy.

The impacts forecast by the Chase model include the following:

- Increased inflation (as measured by the implicit GNP deflator) would total a cumulative 1.8% over the period 1971-76 (less than 0.25% per year).
- Constant-dollar GNP and employment would be unaffected on the average by pollution control expenditures.
- The net foreign balance would be \$2.2 billion lower in 1976 and \$2.8 billion lower by 1980.

- Fixed business investment would be higher by $1.5 billion in 1976, but lower by $0.2 billion in 1980.
- Housing starts would be 140,000 lower in 1976 and 1980.

These results all assume that the government uses fiscal and monetary policy to maintain stability of GNP and unemployment.

B. 1973 Macroeconomic Study

In June 1973 another macroeconomic analysis was completed by Chase Econometric Associates, Inc. This study was an update of the 1971-72 analysis, taking into account more recent pollution control cost estimates and more recent baseline economic conditions. This study used as inputs the costs for pollution control published in the 1973 CEQ Annual Report.

The major impacts shown by this study include the following:

- Increased inflation (as measured by the implicit GNP deflator) would total a cumulative 2.8% over the period 1972-80 (about 0.2% per year).
- Constant-dollar GNP would be $6.5 billion higher in 1973, $5.8 billion lower in 1977, and $15 billion lower in 1980. These differentials average out to a decline of 0.1% in the average annual growth rate over the period 1972-80.
- The unemployment rate would be 0.3% lower in 1973 and 0.1% higher in 1977 and 1980 due to pollution controls. Over the entire period 1972-80, the unemployment rate would be an average of 0.1% higher.

- Fixed business investment (in constant dollars) would be $8.8 billion higher by 1975, $3.1 billion higher in 1977, and $2.3 billion lower in 1980.

C. 1974 Macroeconomic Study

Another update of the macroeconomic analysis is being completed now by Chase Econometrics in a study jointly sponsored by EPA and CEQ. This study is expected to be completed in November and is based on the cost estimates which will be published in the 1974 CEQ Annual Report, as presented in Chapter II of this report. Once completed, the study will be made available to the Committee.

D. Summary

The experience to date in forecasting the macroeconomic impact on the U.S. economy leads to the following general conclusions:

- The impacts on macroeconomic variables such as GNP, and employment are very small compared with the impact of more basic determinants of the state of our economy, such as the business cycle, monetary and fiscal policy, and changes in prices of imported commodities. Impacts at the macroeconomic level, though noticeable, are not of such a magnitude to cause concern about effects on the overall U.S. economy.

- There are some positive effects on the general economy from pollution control investment, as well as the more generally acknowledged negative effects.

- Even though the macroeconomic impacts of these expenditures are relatively small, EPA is concerned over the displacement or narrowly focused impacts which might result for specific firms or industries.

CHAPTER IV

INDUSTRY IMPACT OF POLLUTION CONTROL

As discussed in Chapter III, microeconomic studies of the impact of pollution control on specific industries and specific plants can show the most significant impacts of pollution control expenditures. These studies focus on changes in price, output, employment, viability of plants, and balance of trade that result from regulations on specific plants or industries. Because of the generally mild impacts which the macroeconomic studies have shown, EPA has placed a great deal of emphasis on industry studies so as to focus on potential significant impacts which could be important for specific sectors of the economy, even though they may not affect the key macroeconomic variables.

Two general types of specific industry studies have been performed by EPA. One type focuses on the economic impact of specific regulations on specific industries. Such studies are typically performed as part of the standard-setting process, either to fulfill legislative requirements that economic impacts be considered or for information on the effects of EPA actions where the governing legislation does not allow explicit consideration of economic impacts. The second type of study is one which shows the combined impact on an industry of all environmental regulations which affect it. Such studies have the advantage of showing more comprehensive impacts, though they are not as explicitly related to decisions on specific standards.

This chapter deals with both types of studies. The first comprehensive analysis of the impact of pollution controls on the economy resulted from a set of studies jointly funded in 1971-72 by EPA, CEQ, and the Department of Commerce. These studies projected the combined impacts of all environmental regulations on 14 specific industries, based on estimated costs for meeting environmental requirements which had not at that time been completely defined. Another set of studies has assessed the economic impacts on more than thirty industries of the effluent guideline limitations defined by EPA under the Federal Water Pollution Control Act Amendments of 1972. A similar set of studies assessed the impact of new source performance standards for air. This chapter also provides some information on the combined impact of all regulations on the petroleum refining industry, since that industry is affected by so many different regulations. Plant closings that have allegedly resulted from environmental regulations are also discussed. Impacts on the food and automotive sectors of the economy are each discussed separately in Chapter V and VI respectively.

A. 1971-72 Industry Impact Studies

In March of 1972 EPA, CEQ, and the Department of Commerce published studies of the economic impact of pollution control on 14 basic industries. In all of the industries covered (except automobiles) the study examined the joint impact of air and water regulations. Although the results are outdated because of changes in projected costs for some of the industries, the studies are valuable as a point of comparison with later projections, and as some indication of what the combined effects are of air and water regulations. A summary of the impacts is presented in Table IV-1. Data on automobiles is not included because the Cost of Clean Air Report (1974) has more recent projections which are discussed later in this Chapter.

As Table IV-1 shows, total investment expenditures for these industries for the period 1972-76 were projected to be between \$19 and \$21 billion (\$26 billion when automobiles are included). Approximately 1/2 of this investment was projected for control of pollution from electric power plants. Seventy percent of the utilities' \$10.7 billion expenditure was projected for air pollution control and thirty percent was for thermal pollution control. Two other industries requiring large investments were the pulp and paper industry (17% of total investments covered by these studies) and the steel industry (12-18%). The total impact on the thirteen industries studied, as seen in Table IV-1, was projected as about 600 closures with total resulting unemployment of approximately 41,000. Resultant price increases for goods produced by these industries ranged up to 10 percent, with the average expected price increase being slightly over 3 percent.

Focusing on plant closures and the resulting employment losses, the industries which are most severely impacted are: fruit and vegetable canning and freezing (100 closures and 7000 unemployed), iron foundries (400 closures causing 16,000 lost jobs), and the pulp and paper industry (60-65 closures

TABLE IV - 1
SUMMARY OF COMBINED ECONOMIC IMPACTS FOR 13 INDUSTRIES (1971)

	Total Investment 1972-76	Annual Costs		Closures	Price Increase	Employment Losses
		1972	1976			
	$ Millions					
Baking	12- 21	.4	2.0	0	0	0
Cement	122	3	43	25	4-5%	N.A.
Electric Power Generators	10700.	338	2500	0	2.8-10.7	0
Fruit & Vegetable Canning & Freezing	120	4.3	21.3	100	1.4-2.3	7,000
Iron Foundries	348	6.2	125	400	1.7-5.0	16,000
Leather Tanning	89	2.1	10.7	insignificant	1-2	insignificant
Nonferrous Metals Smelting & Refining - Aluminum	935	22	290	0	5-8	0
Nonferrous Metals Smelting & Refining - Copper	300- 690	6	95	2	0-8	1,150
Nonferrous Metals Smelting & Refining - Lead	70	1.1	20	1	5	200
Nonferrous Metals Smelting & Refining - Zinc	62	1.5	27	N.A.	0	N.A.
Petroleum Refining	634- 1,155	2	21	12	1.9	1,000
Pulp & Paper	3300	N.A.	N.A.	60-65	3.5-10	16,000
Steel Making	2,400- 3,500	45-70	760-1100	00	.7-1.5	0
Total	19,092-21,112	431.6-456.6	3915-4255	600-605		41,350

resulting in 16,000 unemployed). In the fruit and vegetable industry, 90% of the forecast job losses would be seasonal. In the iron foundries, it was estimated that 50% of the 16,000 unemployed would be able to find jobs in other foundries. The losses in the pulp and paper industry were expected to produce significant community impacts in some cases, since many of the closures are likely to take place in rural communities.

Looking at price impacts, the most significant increases forecast were in steel (.7-1.5%), non-ferrous metals (up to 8%), and electricity (2.8-10.7%). These impacts will affect plant and equipment prices causing an estimated .5% increase in investment costs over the 1971-76 period.

B. Impact of Effluent Guidelines for 1977

EPA performs industry economic impact studies as part of the process of developing industrial effluent guideline limitations under the Federal Water Pollution Control Act Amendments of 1972. The impacts projected in these studies are essential to the determination of the best practicable technology standard which must be met by 1977. They allow tradeoffs to be assessed between the effluent reduction and the price increases, plant closings and unemployment associated with alternative levels of effluent control.

EPA is still in the process of promulgating effluent guideline regulations. Consequently, this section will only cover the impact of the first 30 guidelines promulgated. Impact studies will ultimately be completed for each of the sixty industries or segments of industries for which guidelines will be promulgated.

Table IV-2 presents the impacts on 30 industries of the 1977 effluent guideline limitations for Best Practicable Technology (BPCTCA). Some of these industries will incur more costs as additional segments are covered under subsequent regulations. The total impacts for these regulations are:

	($ Million)
Total Investment Required for BPCTCA	$5271 - $7145
Increase in Annual Cost Required for BPCTCA	1440 - 1925
Number of Plants Threatened	300 - 493
Possible Unemployment	7,437 -43,957

Whereas these figures cover costs relating to 30 industries, several industries are responsible for a large share of the total impacts. The petroleum, steam electric, and organic chemicals industries account for 60-70% of the estimated capital expenditures. Additionally, annual operating costs in these 3 industries represent 60-70% of the total incremental costs resulting from pollution abatement expenditures.

Looking at employment impact, the iron and steel industry has by far the largest projected effect with a maximum potential loss of 29,000 jobs, which is equivalent to two-thirds of the total potential job losses. These losses would occur in 8 marginal plants, 5 of which are located in the Mahoning River Valley in the Youngstown, Ohio area. The Agency has announced its

TABLE IV-2

SUMMARY OF ECONOMIC IMPACT OF BPCTCA (PHASE 1)

Industry	Number of Plants*	Total Investment Required for BPTCA ($M)	Increase In Annual Cost Required for BPTCA ($M)	Expected Price Increases (Percent)	Number Threatened Plants	Possible Unemployment	Percent of Total Industry Employment
Asbestos	68	3.3	.8	0.1-1.0%	1 3	275	2%
Beet Sugar	52(47)	4.3-7.7	.4-.8	0-1.4%	1-2	50-100	2-4%
Builders Paper	56(28)	7.0	2.5	3.0-7.0%	3-4	250-350	2-3%
Cane Sugar	29	5.6	1.8	0- .1%	3-5	300-1950	2-16%
Cement	166	18.0	5.9	0.5-1.5%	0	0	0
Dairies	4870(1375)	275.0	28.4	0-1.1%	102	850	0.3%
Electroplating	2374 (546)	119.0	35.0	16.5%	93	580	1.7%
Feedlots	3500	40.0	2.0-3.0	<0.3%	Minor	Minor	Minor
Ferroalloys	22	9.5	4.0	1.2%	0	0	0
Fertilizers	180	100.0	67.0	0-3.5%	23-61	250-1620	1-12%
Fiberglass	31(20)	10.0	3.7	0	0	0	0
Flat Glass	53	1.0	.25	0-.4%	0	0	0
Fruits & Veg.	373	26.0	3.6	0.5-1.0%	6	232	<1.0%
Grain Milling	40(7)	13.0	1.2	0-1.9%	0	0	0
Inorganic Chem.	529	274.0	91.0	0-19.0%	10-19	Minor	Minor
Iron & Steel	63	145.0	40.0	0.2%	0-8	0-29000	0-5.7%
Leather	210(104)	46.0	10.3	0.6-1.3%	21	950	4.0%
Meat Processing	1420(570)	179.0	39.0	0.1%	1	25	0.04%
Non-Ferrous (Al)	126	107.0	35.0	0.8-1.0%	4	160	<1.0%
Organic Chemicals	665(276)	1030-2880	210.0-590.0	1.7-3.7%	Minor	Minor	Minor
Petroleum	251	1112.0	289.0	<1.0%	2-11	500	0.3%
Phosphates	80	9.3	4.9	0.6-1.6%	0	0	0
Plastic & Synthetics	278	300.0	66.0	0.1-2.4%	6-53	1100-3200	1.0%
Pulp & Paper	188(84)	210.0	58.0	3.0-6.0%	7-10	810-1250	1.1-1.6%
Rubber	119	55.0	21.0	0.4-2.1%	0	0	0
Seafoods	327(270)	20.1	4.8	0-1.4%	11	400	0.3%
Steam Electric ** (after 316(a))	1000	1020.0	470.0	0.2%	0	0	0
Soaps & Detergent	1000(20)	14.0	5.0	0-0.6%	0	0	0
Textiles	7080(5680)	80.0-100.0	28.0-30.0	0-2.0%	4	365	1.0%
Timber	993	38.0	13.0	0-8.0%	0-75	0-2150	0-2.6%
Totals	26,143(9027)	$5271-7145	$1440-1925		300-493	7437-43,957	

* Numbers in parentheses represent direct dischargers

** Note that most of the $4.1 billion costs projected for steam-electric plants will result from BAT regulations and are not shown in this chart.

intent to modify the guidelines if additional analysis substantiates the probability of high employment impact in that area. Higher prices and profits may also alleviate some of the impact projected for this industry.

Other industries where the potential employment impact is most significant (where greater than 1000 jobs could be lost) include:

Plastics and Synthetics	1100-3200
Cane Sugar	300-1950
Timber	0-2150
Fertilizers	590-1620
Pulp and Paper	810-1250

These 5 industries account for just over two-thirds of the remaining estimated job losses in these thirty industries.

Product price increases are an inevitable consequence of pollution abatement expenditures. The level of those increases varies considerably among industries due to different industry characteristics -- such as industry structure, substitutability of the product, elasticity of demand for the product, size of pollution control expenditure, and so on. Those industries with the largest expected price increases include:

Electroplating	15-18.0%
Inorganic Chemicals	0-19.0%
Timber	0- 8.0%
Builders Paper	3.0- 7.0%
Rubber	3.0- 6.0%

These industries are not necessarily the most significant in terms of their contribution to inflation, because the effect of price increases in an industry on the overall rate of inflation depends upon the importance of the industry in the national economy. For example, the price increases in electroplating, while very high for the industry, may be less significant in aggregate terms than a much smaller anticipated price increase in the electric industry because the latter industry's total output is so much greater.

The figures in Table IV-1 for the steam electric industry are based on the anticipated level of expenditures after the 316(a) exemptions. According to Section 316(a) of the FWPCA of 1972, exemptions from thermal discharge guidelines may be granted to any operator or owner who can demonstrate that the guidelines are more stringent than required to protect the balanced indigenous population of aquatic life. The economic impacts with and without exemptions for this industry by 1983 are:

	Before Exemptions	After Exemptions
Capital Investment (1974-1983) (billion 1974 dollars)	6.6	4.1
Price Increase (% cost to final user)	2.2	1.5
Capacity Penalty (% of national capacity)	1.0%	0.6%
Fuel Penalty (% of national demand for energy)	0.3%	0.2%

The fuel penalty indicates the percentage of national energy demand which will be required to run the pollution control equipment.

C. Impact of Air New Source Performance Standards

The Agency has promulgated New Source Performance Standards (NSPS) for air pollution from 11 industries. Economic analysis reveals that no significant impact will result from these standards. Table IV-3 presents the estimated product cost increases resulting from the standards. These figures represent the incremental cost of Federal regulations beyond those cost increases caused by compliance with State regulations. The baseline of costs due to State Implementation Plans (SIP's) was derived by estimating the probable level of State control over a plant considered representative of new plants recently constructed by a particular industry. As Table IV-3 indicates, in seven of the eleven industries the increase represents less than 1% of the product cost. The cost increase for municipal incinerators is high because it represents the total cost of meeting Agency standards rather than the incremental cost (no data was available on costs resulting from state controls).

At present, the Agency is preparing NSPS for 11 additional industries. In ten of these industries the estimated cost increase is less than 1%, with increases of 2.8% anticipated for the primary aluminum industry. Table IV-4 presents the anticipated impacts in summary form.

TABLE IV - 3

ECONOMIC IMPACT OF PROMULGATED AIR NEW SOURCE PERFORMANCE STANDARDS*

Industry	Incremental Costs	Cost of Increases As a % of Product Cost (1974 Prices)
1. Steam Electric Power Plants	N/A	0-3%
2. Sulfuric Acid Plants	$.10-.70/ton	.2-1.7%
3. Portland Cement Plants	$.03-.04/bbl	.5-.6%
4. Nitric Acid Plants	0	0
5. Municipal Incinerators**		4-13%
6. Asphalt and Concrete	$.03/ton	.4%
7. Basic Oxygen Furnace (Steel Industry)	0-$.10	0-.04%
8. Secondary Lead	0	0
9. Brass and Bronze Manufacturing	0	0
10. Petroleum Refining	0	0
11. Sludge Incinerators	$.01-.04/person/yr	1.5%

* The figures represent the estimated cost of EPA regulations above those costs resulting from SIP's.

** Respresents total cost because no data was available on costs resulting from SIP's.

TABLE IV -4

ECONOMIC IMPACT OF PROPOSED AIR NEW SOURCE PEFORMANCE STANDARDS

Industry	Incremental Cost	Cost Increase As a % of Product Cost1/
Coal Cleaning Operations (metallurgical coal)	$.02/ton	.1%
Ferro-Alloy Manufacturing	0	0
Primary Aluminum Industry	$.01/lb	2.8%
Wet Process Phosphoric Acid	0	0
Superphosphoric Acid (submerged combustion process)	$.28/ton	.1%
Diammonium Phosphate	0-$.43/ton	.2%
GTSP (Triple Superphosphate)	0-$1.61	0-1%
Electric ARC Furnance	0	0
Primary Copper Smelting	$.002/lb	.2%
Primary Lead Smelting	$.001/lb	.4%
Primary Zinc Smelting	$.001/lb	.3%

1/ Based on 1974 product costs.

D. Petroleum Refineries

In order to comply with pollution control regulations, the petroleum refining industry will need to invest considerable sums in the 8 year period from 1973 to 1980. This investment includes:

Direct Impact from Regulations	$2.3 billion
Indirect Impact from Regulations	0.6-2.7 billion
Total	2.9-5.0 billion

Total annual investment by the industry is expected to be from $2 to $3 billion. Therefore the total investment required by pollution control represents from 12% to 31% of per annum investment in refinery construction, assuming that the investment is spread evenly over the 8 year period. This wide range is due to the uncertainty regarding the total investment required to desulfurize fuel oil (an indirect impact).

The annualized incremental costs total $0.8 to $1.0 billion when direct and indirect impacts are combined. These annualized costs include operating and maintenance plus amortization of pollution control investments, and are divided as follows:

Direct Impact from Regulations	$0.7 billion
Indirect Impact from Regulations	$0.1-0.3 billion
Total	$0.8-1.0 billion

TABLE IV-5

IMPACT ON REFINERIES

Source	Year	Total Capital Investment ($-MM)	Incremental Annualized Cost ($-MM)	Cost Per Barrel Covered (¢/bbl)	Energy Loss (Thous. bbl/day)
Direct Impact:					
1. Air pollution control (Existing plants)	1973-80	577	148.0	3	Not Supplied
plus Substitution Low for Hi S Fuel			108.0	2¼	
2. Water Pollution Control (Existing plants)	1973-80	1,378	358.2	7	3.5
3. Lead-Free Gasoline	By 1980	255	82.5	5½	50
4. Low-lead Gasoline	By 1970	82	14.0	0.4	Net Savings
Subtotal		2,292	711	18	
Indirect Impact:					
1. Fuel Oil Desulfurization	1973-80	580-2710	70-340	10-25 distillates 75-95 resid.	N.A.

When these costs are translated into per barrel price effects, the impact is slightly below 30 cents per barrel. This cost figure does not represent the precise price increase resulting from pollution control, but rather it is meant to give an indication of the cost pressures resulting from the regulations.

E. Plant Closings to Date

In order to keep track of the actual impacts of environmental regulations on specific plants, and where possible do something to limit the impacts, EPA runs an Economic Dislocation Early Warning System. This is a reporting system for threatened or actual plant closings or production cutbacks allegedly due to pollution control regulations.

This system results in immediate notification of the Department of Labor (DOL) , Small Business Administration (SBA), and Economic Development Administration (EDA) whenever EPA learns of a potential or actual plant closing. This notification is intended to bring into play any government programs available to provide financial assistance which would prevent plant closings or production curtailments or to assist workers and communities impacted by closings and curtailments. Immediate notification is performed at the regional level through the mechanism of the Federal Regional Councils. In addition, a quarterly report on plant closings or cutbacks is transmitted from the Administrator of EPA to the Secretary of Labor and the Administrators of SBA and EDA.

Since this quarterly report was initiated in 1971, actual and threatened job losses, exclusive of plants removed from the listings after initial recording, have been reported for 150 plants. Of these, actual closings or curtailment of production in 69 plants have resulted in the loss of approximately 12,000 jobs. The 81 plants currently threatening to close or curtail operations could potentially dislocate an additional 44,000 workers. The actual and threatened closings and job losses are concentrated in the following three industries (59 percent of the plants and 81 percent of the jobs impacted):

- Pulp and Paper
- Primary Metals
- Chemicals

Tables IV-6, IV-7, and IV-8 summarize the statistics compiled through the second quarter of 1974 on current actual and threatened economic dislocations allegedly due to environmental standards. Since this report was initiated in 1971, 28 plants have been removed from the inventory of threatened or actual closings. It is significant to note that of 69 plant closings reported to date only 9 involve solely Federal enforcement action, while 5 more involve both Federal and State action.

Another important observation is that analysis of these threatened and actual closings shows them to be almost entirely limited to small, old, and marginal plants. A variety of reasons cause these plants to be economically marginal. In most cases,

TABLE IV-6
PLANTS AFFECTED – ACTUAL AND [THREATENED] CLOSINGS WHERE POLLUTION CONTROL COSTS WERE ALLEGED TO BE A FACTOR
JANUARY 1971 THRU JUNE 1974

REGION \ INDUSTRY	PAPER AND ALLIED PRODUCTS	PRIMARY METALS	CHEMICALS AND ALLIED PRODUCTS	FOOD PRODUCTS	STONE, CLAY, GLASS, AND CONCRETE PRODS	MINING & QUARRYING NON-MET. MINERALS	TEXTILE MILL PRODUCTS	OTHER INDUSTRIES 3.	TOTAL
I	2 [5]					[1]	3 [1]	1 [4]	6 [11]
II	3 [1]	1 [2]	3	1		1	1	8 [2]	18 [5]
III		[1]	2 [2]	2 [1]	[1]			3 [4]	7 [9]
IV	[4]	1	1 [4]		[1]		[1]		2 [10]
V	2 [10]	5 [11]	[5]	3	3			1 [2]	14 [28]
VI	[1]	3 [2]						1	4 [3]
VII									
VIII			1			2			3
IX	[1]	2 [5]	[3]	2 [2]	2	1 [1]		2 [1]	9 [13]
X	3 [1]	[1]		1				2	6 [2]
TOTAL: ACTUAL [THREATENED]	10 [23]	12 [22]	7 [14]	9 [3]	5 [2]	4 [2]	4 [2]	18 [13]	69 [81]
GRAND TOTAL	33	34	21	12	7	6	6	31	150
PERCENT	22	23	14	8	5	4	4	21	100 %

NOTES:

1. Economic dislocation information is compiled and reported by EPA Regional Offices.
2. Dislocations involving less than 25 jobs are NOT reported.
3. "Other Industries" includes all dislocations where the combined "Actual" and "Threatened" plants amount to less than six.

TABLE IV-7

JOBS AFFECTED–ACTUAL AND [THREATENED] CLOSINGS WHERE POLLUTION CONTROL COSTS WERE ALLEGED TO BE A FACTOR

JANUARY 1971 THRU JUNE 1974

INDUSTRY / REGION	PAPER AND ALLIED PRODUCTS	PRIMARY METALS	CHEMICALS AND ALLIED PRODUCTS	FOOD PRODUCTS	STONE, CLAY, GLASS, & CONCRETE PRODS.	MINING & QUARRYING NON-MET. MINERALS	TEXTILE MILL PRODUCTS	OTHER INDUSTRIES 3	TOTAL
I	1,013 (624)					200	(250)	95 (175)	1108 (1,249)
II	1,536 (141)	44	1,450 (155)	102		25	133	1,308 (513)	4598 (809)
III		(50)	610 (2,040)	105 (89)	(87)	–		390 (1,692)	1105 (3,958)
IV	(942)	148	78 (1,566)						226 (2,508)
V	500 (2,271)	1,379 (24,562)	(1,110)	(165)	235			(3,200)	2,279 (31,143)
VI	(850)	540 (1,241)			–			45	585 (2,091)
VII									
VIII						208			208
IX	(50)	400 (415)	(336)		148	35 350		529 (50)	1,112 (1,201)
X	833 (346)	(800)		38				250	1,121 (1,146)
TOTAL: ACTUAL (THREATENED)	3,882 (5,224)	2,511 (27,068)	2,138 (5,207)	410 (89)	383 (87)	268 550	133 (250)	2,617 (5,630)	12,342 (44,105)
GRAND TOTAL	9106	29,579	7,345	499	470	818	383	8,247	56,447
PERCENT	16	52	13	1	1	1	1	15	100 %

NOTES

1 Economic dislocation information is compiled and reported by the EPA Regional Offices

2 Dislocations involving less than 25 jobs are NOT reported.

3 "Other Industries" includes all dislocations where the combined "Actual" and "Threatened" counts amount to less than 50.

TABLE IV-8

PLANTS AFFECTED: ACTUAL AND (THREATENED) CLOSINGS WHERE POLLUTION CONTROL COSTS WERE ALLEGED TO BE A FACTOR BY CONTROL PROBLEM AND ENFORCEMENT ACTION

JANUARY 1971 THRU JUNE 1974

	CONTROL PROBLEM			ENFORCEMENT ACTION					
REGION	AIR	WATER	AIR AND WATER	STATE	FEDERAL	FEDERAL & STATE	LOCAL	OTHER [3.]	TOTAL
I	(6)	5 (4)	1 (1)	2 (6)	4 (4)			(1)	6 (11)
II	10 (4)	5 (1)	3	17 (5)	1				18 (5)
III	2 (4)	5 (5)		6 (7)	1 (2)				7 (9)
IV	2 (2)	(8)		1 (3)	(1)	(4)	1 (2)		2 (10)
V	9 (4)	4 (18)	1 (6)	10 (8)	(7)	2 (5)	2	(8)	14 (28)
VI	4 (2)	(1)		4 (2)	(1)				4 (3)
VII									
VIII		2	1			1		2	3
IX	6 (10)	3 (3)		3 (8)	3 (3)	1 (2)	2		9 (13)
X	1 (1)	4 (1)	1	2		1 (1)	1 (1)	2	6 (2)
TOTAL: ACTUAL (THREATENED)	34 (33)	28 (41)	7 (7)	45 (39)	9 (18)	5 (12)	6 (3)	4 (9)	69 (81)
GRAND TOTAL	67	69	14	84	27	17	9	13	150
PERCENT	45	46	9	56	18	11	6	9	100 %

NOTE:

1. Economic dislocation information is compiled and reported by the EPA Regional Offices.
2. Dislocations involving less than 25 jobs are NOT reported.
3. "Other" includes civil actions, cases where no enforcement action was instituted, and cases where the type of action was NOT reported.

the environmental requirements appear to be at most "the straw that breaks the camel's back," often hastening a closing which seems inevitable in the near future even without environmental requirements. In fact, in a number of cases, it is impossible to tell whether or not the plant could have remained viable if environmental requirements had not been a factor.

CHAPTER V

IMPACTS OF POLLUTION CONTROL ON AGRICULTURAL PRODUCTION

Current and future regulations are expected to have minor impacts on agricultural production. Of the Agency's programs which affect agriculture, regulation of pesticide use could have the most significant impact on food and fiber production. The costs and impacts of pesticide cancellation and suspension actions have been discussed in Section II-E, so they will not be further discussed here.

Environmental requirements in the fertilizer industry are second in importance. Finally, minor production, price, and employment impacts are anticipated in feedlots and various food processing industries. Additional impacts may also result from control of non-point sources of water pollution.

Looking at the fertilizer industry, economic analysis indicates that there will be some closures in both the phosphate and nitrogen fertilizer sectors as a result of effluent guidelines. The maximum closures as a percentage of each industry's productive capacity are:

	BPT (1977)	BPT & BAT (1983)
Nitrogen	3.8%	8.1%
Phosphate	10.4%	22.0%

(See Table V-1 for a detailed breakdown of each sector)

These closures probably overstate potential production losses since the calculations were based on 1972 prices. Since 1972, fertilizer prices have increased substantially (in the case of nitrogen fertilizers, over 100% in a 12 month period) with the result that

V-a

TABLE V-1
PRICE AND PRODUCTION EFFECTS OF ENVIRONMENTAL REGULATIONS ON FOOD PROCESSING AND FERTILIZER INDUSTRIES

Industry	External Price Effects		Loss Of Productive Capacity		Number of Plant Closures	
	BPT	BPT + BAT	BPT	BPT+ BAT	BPT	BPT + BAT
Beet Sugar[1]	.2-.8%	-[7]	2-4%	4-8%	1-2	2-4
Cane Sugar Refining[2]	0-1.7%	0-2.1%	6-11	6-11%	3-5	3-5
Dairy Processing	0-1.1%	-	.2%	.6%	102	400
Fertilizers						
Ammonium Nitrate	3.5%	5.0%	5-8%	16-24%	2-10	2-11
Urea	3.5%	5.0%	2-9%	2-11%	2-10	2-11
Ammonia	3.5%	4.2%	.3-.7%	.3-7%	-	-
Diammonium Phosphate[3]	-	-	0-10%	9-19%	-	3-16
Triple Superphosphate[3]	-	-	2-11%	2-11%	1-3	1-3
Fruits & Vegetables Phase I	.5-1.0%	.5-1.3%	6% (citrus)	6%	2	2
			4% (apple products)	4%	4	4
Grain Milling[4]						
Ready-To-Eat Cereals	.2-.6%	-	-	-	-	-
Wheat Starch Processing	0-1.9%	-	-	-	-	-
Meat Processing[5]	0-.1%	.3%	0-.04%	0-5%	1	67
Seafood Processing Phase I[6]						
Tuna	.1%	.4%	-	-	-	-
Catfish	-	-	-	-	2	9
Crab	1.1%	3.1%	-	6	5	12
Shrimp	.4%	1.3%	-	6	4	16

[1] New plants in Minnesota & North Dakota will offset production losses.

[2] 11% BPT Closures are divided into 2% closures in Puerto Rico and 9% mainland closures.

[3] No price effect in the phosphate fertilizer industry due to excess industry capacity.

[4] In both citrus and apple products, it is anticipated that other firms in the industry will pick up the lost production.

[5] Most of the closures will be small packinghouses (16) and small slaughterhouses (45).

[6] Alaskan crab and shrimp industries will be severely affected by BAT guidelines. Closures would represent 10-15% of productive capacity for Alaskan crab and 30-40% of capacity for Alaskan shrimp.

[7] A "-" indicates no impact.

pollution control costs no longer represent as high a percentage of a firm's annual sales as previously indicated. The high maximum closure rate was predicated on an assumption that there would be excess production capacity by 1975 and that many older and more marginal plants would close, even in the absence of environmental controls. It is now doubtful that this will happen; and even if it does, the loss relative to 1977 capacity will be appreciably less.

Any closures in the nitrogen fertilizer industry could be serious due to the shortage of this commodity, a shortage projected to last for several years due to insufficient plant capacity. However, new plants recently announced appear likely to alleviate this potential problem.

In all of the food processing industries which have been studied to date, with the possible exception of cane sugar refining where a maximum loss of 11% of productive capacity has been predicted, the estimated economic impact is not of significant concern. Even the impact projected for cane sugar refining is not necessarily cause for concern since under current price levels, the impact will be much smaller than previously predicted. An 11% loss would only be experienced if sugar prices were to fall to mid-1973 levels. In nearly all industries, either the production effect is insignificant (less than 2% reduction in productive capacity due to closures attributable to pollution regulation) or sufficient excess capacity exists to absorb the lost capacity. For a summary of the price and production effects see Table V-1.

The current guidelines for the feedlot industry are not expected to result in significant impact. The guidelines apply only to large scale operations, and annual costs to meet pollution control will be passed on in the form of higher prices in the range of 0.1 to 1.5%. No closures are anticipated based on financial analysis, although a few feedlots may close due to land availability constraints.

CHAPTER VI

ECONOMIC IMPACT OF ENVIRONMENTAL REGULATIONS ON THE AUTOMOBILE INDUSTRY

There are three primary regulatory areas where EPA has a major impact on the automobile industry:

(1) The imposition of exhaust emission standards on new cars and trucks, required by Section 202 of the Clean Air Act;

(2) The warranty requirement that vehicles in use meet the emission standards for 5 years or 50,000 miles; and

(3) The promulgation of transportation control plans in cities which cannot meet ambient air quality deadlines through other control measures.

The magnitude of these impacts and their timing will depend on several unresolved issues now being studied by EPA and the Congress. They include the question of the proper amount of control needed for automobile emissions of nitrogen oxides (NOx), the degree to which emissions of sulfur oxides (and their conversion to sulfates) from catalyst-equipped cars are harmful, and the implementation of transportation control plans.

The automotive industry has been working on pollution control for over ten years; and since passage of the 1970 Clean Air Act Amendments, its efforts have accelerated. From 1967 through 1973, Chrysler, Ford and General Motors spent close to $2 billion for emissions control research and development. Of this amount, 75% has been spent since 1970, when the Amendments were passed.

The companies spent $423 million in 1972 and $738 million in 1973, or $1. 2 billion in the last two years alone. Of these amounts, capital expenditures accounted for 29% and 46%, respectively, of total emissions expenditures in those years.

Expenditures for 1974 and 1975 were projected last summer to be approximately $967 million and $765 million, respectively. As an indication of the shift in importance of emission controls in the industry, emission control costs have grown from 4% of total research and development expenditures in 1967 to 20% in 1973. Although accounting methods differ from company to company, these expenditures generally include all direct costs associated with developing emission control devices, capital expenditures for facilities and equipment to manufacture and test them, and overhead costs.

Emission control expenditures have been directed primarily towards modifying the traditional internal combustion engine and developing add-on devices to control emissions, rather than to development of inherently low-polluting engines. The auto companies have spent many millions of dollars developing new carburetors, high energy ignition systems, exhaust manifolds, air pumps, and catalytic converters -- all to reduce pollution emissions from what is basically the same engine they have been using for over seventy years. Many of these projects, such as the new carburetors and high energy ignition systems, while developed principally to help control emissions, also contribute to improved fuel economy and performance and to lower maintainence costs. Therefore, the impetus of emission controls has also caused the automobile companies to improve the quality of their engines.

Another major area of expenditure is for the development of low-pollution alternatives to the traditional internal combustion engine, with the emphasis on improving fuel economy in today's cars. Some of these alternatives are receiving even more priority today because of their good fuel economy. These shall be discussed in more detail later.

A. Capital Expenditures for Pollution Control

As stated earlier, the largest portion of the auto manufacturers' emission control expenditures in 1973 and 1974 will be for facilities and tooling needed to manufacture and assemble pollution control equipment. A total of $338 million in 1973 and an estimated $660 million in 1974 will be spent on emission control facilities and tooling. This is 46% and 70%, respectively, of the Big 3 emission control expenditures. Catalytic convertor facilities undoubtedly make up the major part of these expenditures, since catalysts are a new technology with no existing facilities. General Motors has installed seven transfer or assembly lines to manufacture and install catalytic converters. Ford and Chrysler, on the other hand, are having their catalysts manufactured by suppliers and are only installing the completed assembly.

In addition to the special tooling needed for catalysts, capital expenditures will be used on tooling and equipment needed for testing and possibly manufacturing new ignition systems and engine carburetor modifictions, as well as changes in chassis design to accept catalysts. It's not clear, though, how much of these costs should be attributed to emission controls since many of these changes are, in reality, an improvement in the quality of new cars.

B. Increased Cost of Auto Due to Emission Controls - 1975, 1976, and 1977 Model Years

According to estimates submitted by the manufacturers in November 1973, emission controls on 1975 model year cars will cost from $130 to $200 more than 1974 cars. EPA has estimated the average cost to be $165 across all makes and models. These costs reflect the simplified systems used to meet the 1975 interim standards; they include not only the catalyst, but also improved carburetors on some cars and high energy electronic ignition systems as well on most cars. Catalysts alone are expected to cost from $60 to $90 per car.

Under the current Clean Air Act legislation as amended in 1974, the incremental costs of 1977 models over 1975 cars are estimated by the manufacturers to be from $50 to $150 per car. However, since the large majority of 1975 cars will already have installed complete emission control systems, EPA estimates that the average additional costs of a 1977 car (over 1975 cars) will be closer to an increment of only $20, or $185 above 1974 cars. Other estimates by different studies seem to back up the EPA figure. For instance, the joint DOT/EPA study on the Potential for Motor Vehicle Fuel Economy Improvement estimated the increment of list price for a 1977 car meeting statutory HC and CO standards and an interim NOx standard of 2.0 gm/mi over a 1974 car at $150 and $225 for small and large cars, respectively. In addition, the recent NAS study for the U.S. Senate, Air Quality and Automobile Emission Control, estimates the incremental list price of a 1977 intermediate car over an equivalent 1974 car at only $126, with the price of a 1978 car meeting the statutory NOx standards estimated to be an additional $126. Compared to systems needed to meet the 1975 and 1977 standards, early emission control devices were relatively simple and did not cost as much. For example, the additional cost on 1974 cars is about $80 over uncontrolled, pre-68 cars.

There are two types of emission control systems which show some promise of meeting the statutory exhaust emission standards for HC, CO, and NOx in 1978: (1) a dual catalyst system with an oxidation catalyst to clean up HC and CO and a reduction catalyst added to the 1975-type system to control NOx, and (2) a modification to the 1975 single catalyst system which feeds back information on the exhaust pollutants in order to control the carburetor and give the catalyst optimum operating conditions. This latter system is often referred to as a "three-way" catalyst since it controls all three pollutants simultaneously. These systems are still in the development stage and have not reached the point where production decisions and commitments can be made by the manufacturers. The 1978 model cars meeting statutory standards are estimated by EPA to cost an additional $80, on the average, if a dual catalyst system is used with a base metal reduction catalyst. The manufacturers' estimates, which are based on an expensive ruthenium/platinum reduction catalyst, range from $150 to $300 more than the cost for a 1977 car. The base metal catalyst has performed much better than the ruthenium type, and is much cheaper as well.

C. Impact on Fuel Economy

Emission controls have contributed to the decreased fuel economy, but have not been the main factor accounting for the increase in gasoline consumption. Since 1965, average fuel economy of all cars has been falling about 1% per year due to the increased weight of new cars and to bigger engines as well as emission controls. Yet national gasoline consumption has been rising at 3-7% per year. Clearly, a drop in fuel economy does not alone account for the rapid rise in consumption. The primary factor has been the very large increase in cars on the road each year. Vehicle registrations nationally have been growing about 3-4% each year. This alone accounts for over 60% of the rise in gasoline consumed since 1968 -- the first year emission controls were installed on new cars sold nationwide. The other factor controlling consumption is the number of miles travelled each year. The average vehicle traveled over 10,100 miles per year in 1974 compared to 9,600 in 1968 -- an increase of approximately 1.3% annually.

These factors, increased weight, bigger engines, more cars on the road, and more miles travelled, are more important than emissions controls in accounting for the increased gasoline consumption. Since 1968, only 9% of the additional gasoline consumed by passenger cars can be attributed to the drop in fuel economy and a significant portion of this 9% is due to the increasing use of air conditioning and other accessories.

D. Aggregate National Costs and Macroeconomic Impacts

In addition to the unit cost increases borne by the consumer and the impact on the manufacturers, we should consider the aggregate investment and operating costs to the nation of installing emission controls on automobiles. Balanced against these costs is the substantial reduction in airborne pollution caused by automobiles.

Through 1973, the total initial cost to the consumer of emission controls has been just over $2 billion, covering almost 60 million cars since 1968. However, from 1974 through 1980, about the same number of years, EPA estimates the additional initial costs will total $26 billion for emission controls, reflecting the much higher cost of the systems needed to control automobile pollution to the levels required by the Clean Air Act after 1975.

Operating and maintenance costs have been an additional $7 billion through 1973 and may be $35 billion from 1974 through 1980, assuming catalysts are used throughout the 1975 to 1980 period. Unit maintenance costs for 1975 and subsequent years will be less than for 1974 cars because of the electronic ignition systems used by all manufacturers and the increased exhaust system life brought about by the use of leadfree gasoline.

The macroeconomic effects of these controls on the automobile industry were analyzed in a jointly-funded study by EPA, CEQ, and the Department of Commerce. This 1971 study concluded that the overall effects of emission control standards would be to reduce new car sales by perhaps a few hundred thousand units at most. Compared to other market factors, this would seem to be a moderate impact. Other economic factors such as ability to raise needed capital, profits, etc., are not projected to be substantially affected.

While the auto emission standards have had an impact on the industry, they have also contributed to the birth of a new industry -- the automobile catalyst industry. Several companies have invested a substantial amount of funds to tool up for building the catalyst and its container. At least six new plants have been built by catalyst manufacturers to supply the automotive industry. Therefore, this impact has and will be felt, not only by the manufacturers, but by suppliers as well -- including some who have never dealt with the automotive industry before.

E. Two-Car Strategy

Some people have questioned the need for automobile pollution controls in communities where air pollution is not a severe problem. This concept has been called the "two-car" strategy. They suggest that the economic impact of automotive emission standards would be much smaller if cars in clean areas were not required to have pollution control equipment. EPA believes that it would not be practical, for several reasons:

1. Cars are highly mobile. A car registered in a relatively clean area will on occasion be driven to nearby cities. It would be almost impossible to control where an automobile might be operated.
2. Even if it were possible to prohibit the sale and initial registration of uncontrolled cars in heavily polluted cities it probably would be impossible to control the sale of used uncontrolled cars in such cities. In fact, such uncontrolled cars are likely to be driven a few miles and then "bootlegged" for resale in cities almost immediately, thus circumventing the law.
3. Beginning with the 1975 model year, stringently controlled automobiles will require unleaded gasoline to protect their catalytic converters. Because of these requirements, they might have serious problems being refueled in those areas of the country in which such unleaded fuel -- and repair parts for stringently controlled cars--would not be readily available. The average citizen's mobility would thus be unacceptably impaired.

In regard to the importation of used cars into California that do not meet the more stringent California emission standards, not even California, with its almost 10 years experience in imposing its own emission standards on new cars, has yet devised and implemented a way of prohibiting their sale in California.

F. Summary

In summary, EPA's regulations -particularly the new car emissions standards -- have had probably the greatest impact on the automotive industry of any Federal action in the last thirty years. These impacts include the following:

- o The automobile manufacturers have spent over $2 billion on emissions control development, the bulk of it in the last four years,
- o Prices of 1978 cars may include more than $350 of pollution control expenditures relative to uncontrolled cars due to emission controls, but at least $80 of this would be eliminated if Congress were to relax the statutory NOx standard sufficently.
- o Fuel economy in new 1975 cars is somewhat better on a comparable weight basis than in pre-controlled cars. The 1973 and 1974 models showed 10% and 8% fuel economy reductions respectively.
- o The incremental cost of 1975 cars due to emission controls (approximately $165 over 1974 cars) is far outweighed by the savings in operating and maintenance costs; for a standard size car, the lifetime savings would be $370 in maintenance costs alone, due to improved electronic ignition systems and use of unleaded gasoline,
- o Macroeconomic impacts of emissions regulations have been moderate.

- Uncertainty surrounding the standard for nitrogen oxides potential is causing concern in the industry,
- Macroeconomic impacts of emissions regulations have been moderate.

CHAPTER VII

EFFECTS ON INDIVIDUALS

The previous chapters have discussed the costs and economic impacts of pollution control expenditures on the U.S. economy in general, on specific sectors of the economy, on specific industries, and on specific industrial plants. This chapter will cover yet another important aspect of the economic impact of the Federal pollution control program -- the impact on individuals. Of special importance in looking at the impact of these costs on individuals is the impact on individuals or families of different income levels.

The analysis of who pays for pollution control is important because ultimately every pollution control expenditure filters down to individuals. Pollution control costs paid for by industry filter down to the individual in the form of higher prices for goods and lower dividends on equity investments. Pollution control costs paid for by Federal, State, and local governments filter down to individuals in the form of higher taxes, higher prices from others who must pay taxes, higher charges for some government-supplied services, and a lower level of services for a given level of taxes.

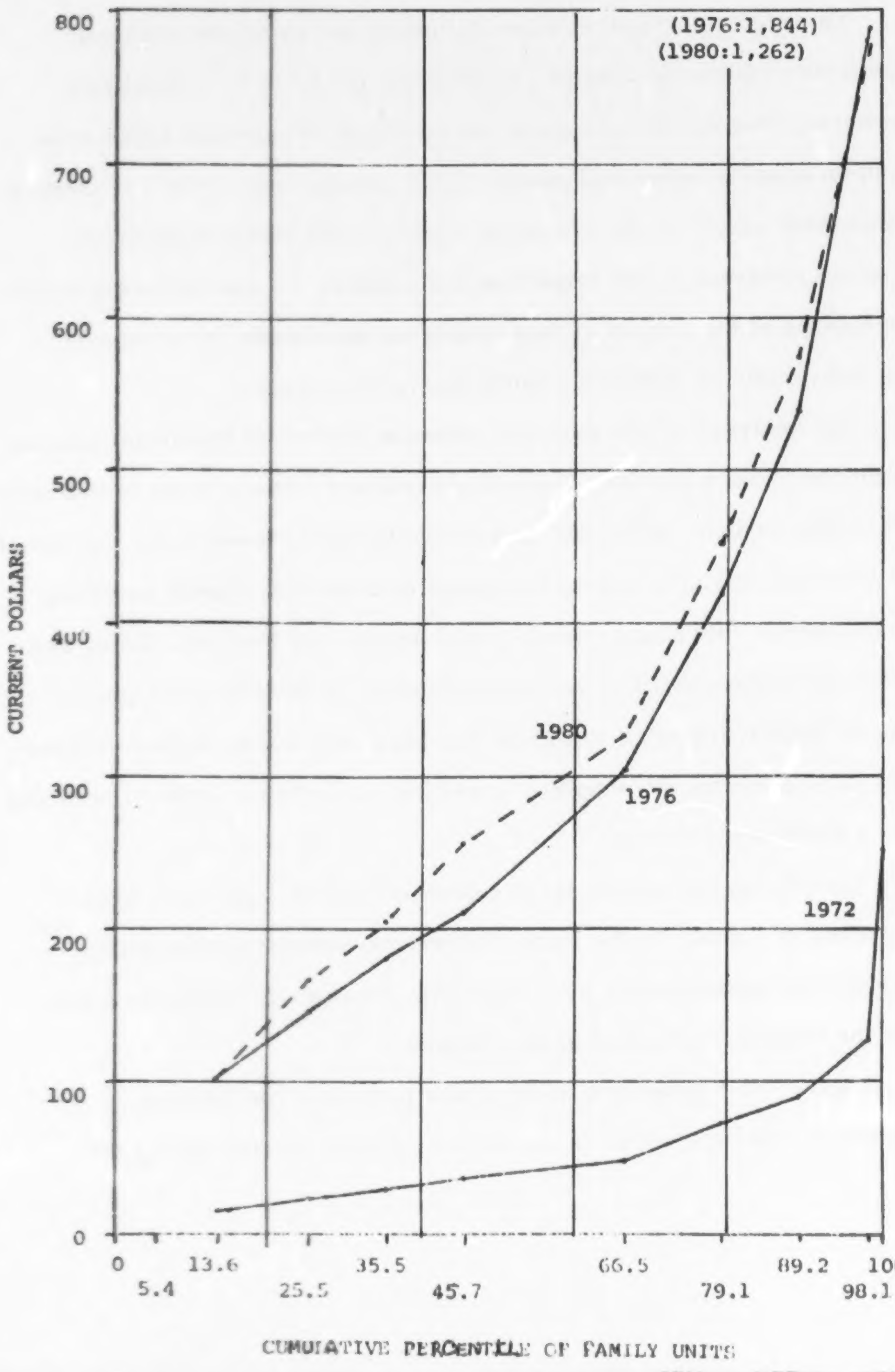
The effects on individuals of pollution control costs have been analyzed in a study by the Public Interest Economic Center which was jointly sponsored by EPA and CEQ. That study forms the basis for the impacts discussed in this chapter.

Figure VII-1 shows the dollar costs projected for families of all income levels as a result of the entire Federal environmental program.

VII-1-a

FIGURE VII-1

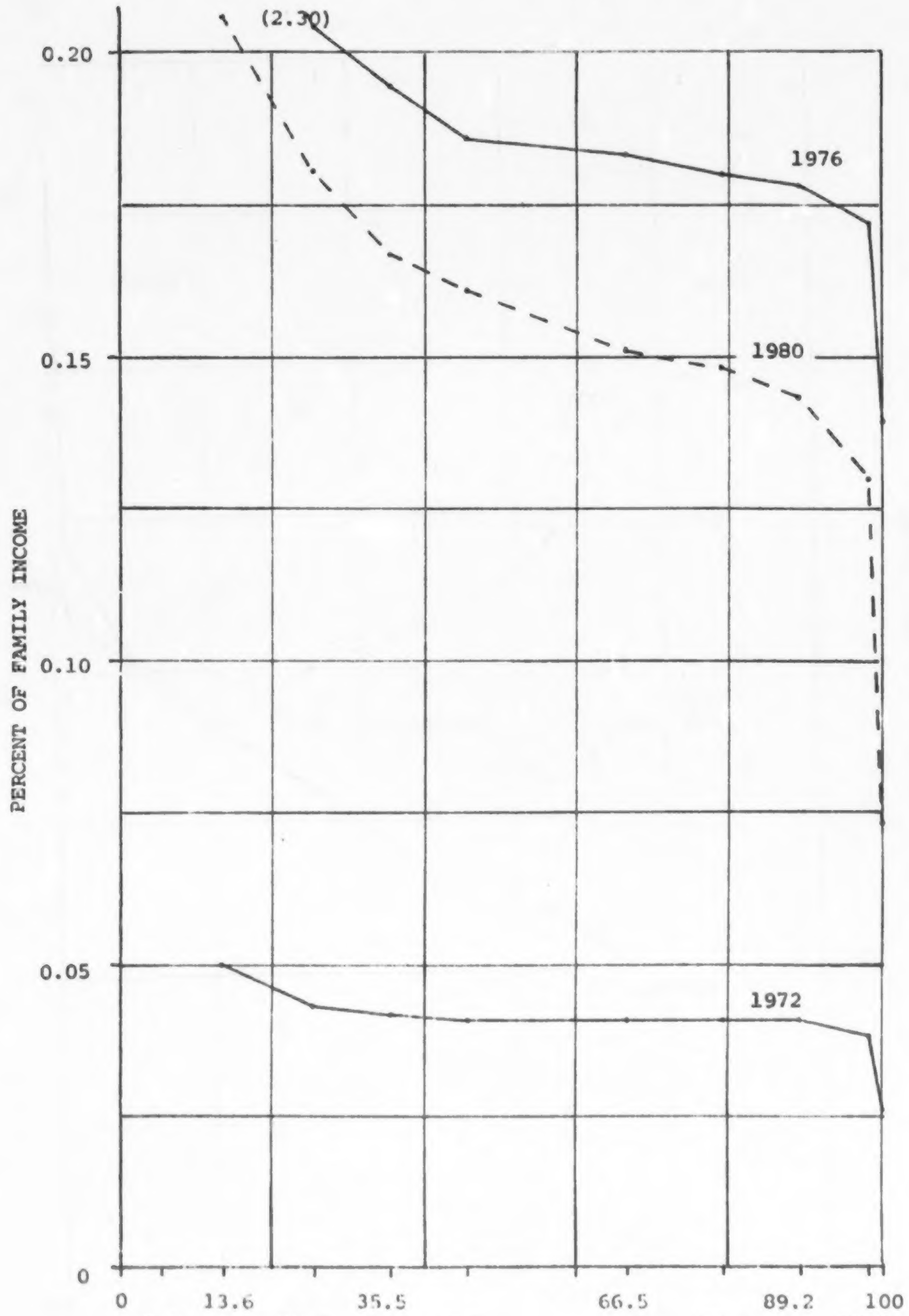
SUMMARY DISTRIBUTION FOR 1972, 1976 AND 1980
TOTAL DOLLAR COST PER FAMILY UNIT



VII-1-6

FIGURE VII-2

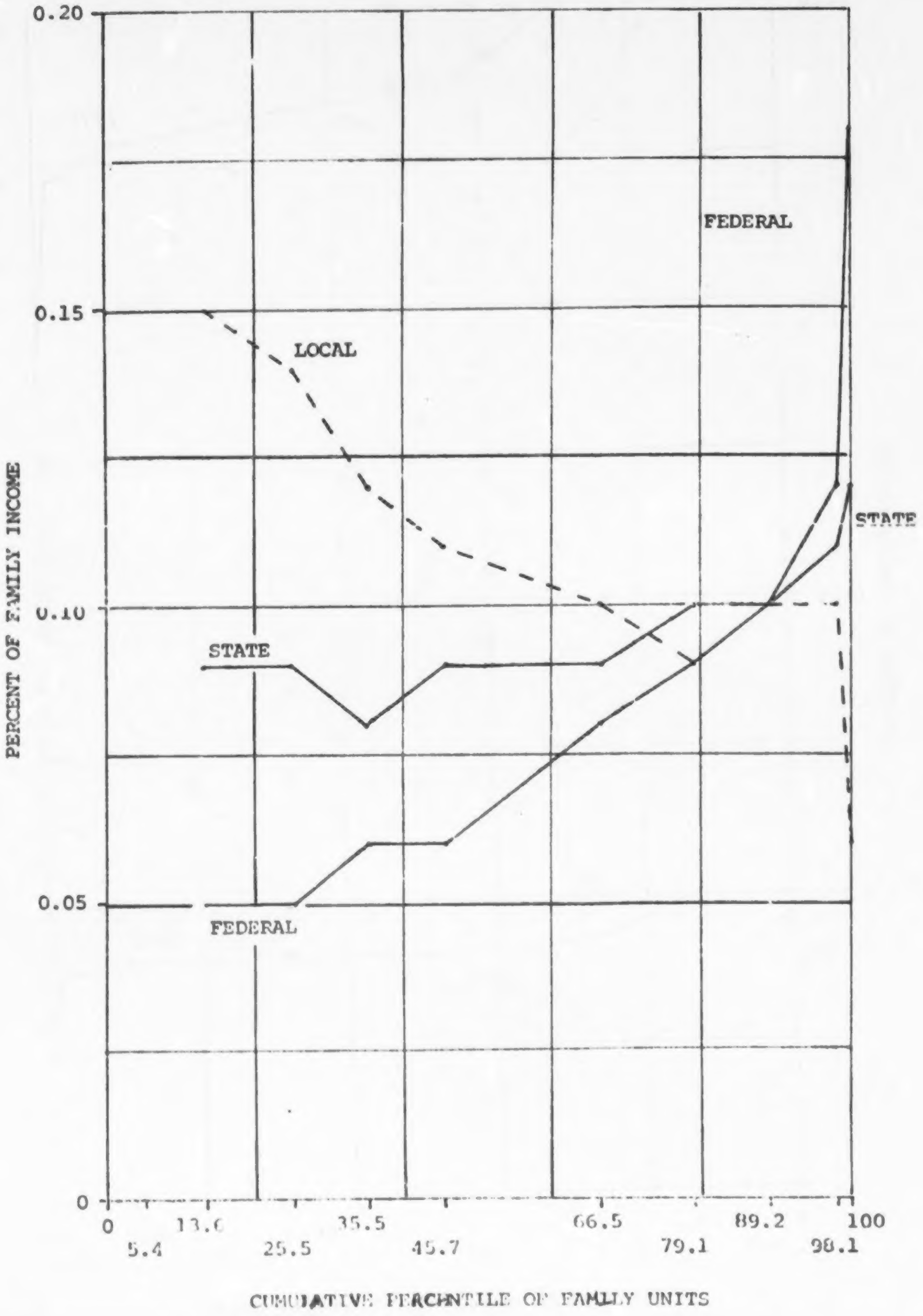
SUMMARY DISTRIBUTION FOR 1972, 1976 AND 1980
TOTAL DOLLAR COST AS A PERCENT OF FAMILY INCOME



VII-1-C

FIGURE VII-3

DISTRIBUTION IN 1972 OF $1 BILLION INCREASE IN FEDERAL, STATE AND LOCAL TAXES



The curves in Figure VII-1 assume that there is a considerable degree of market imperfection, an assumption which is more valid in the short-run than the possible alternative assumption of a highly competitive economy with perfect mobility of resources. The assumption used for these curves shows slightly higher costs for low-income families and slightly lower costs for high-income families than would the alternative assumption.

Figures VII-1, 2 and 3 show the impacts (either absolute or percentage) on income versus level of family income. The latter is represented by where a family falls in the percentile of all families, the lowest income bracket being at the zero or far left point of the scale.

Naturally the absolute level of impact increases with income level, since tax payments and consumption increase with income level. Of particular interest though is the percentage of family income accounted for by pollution control costs. Figure VII-2 shows the same impact as a percent of family income for the years 1972, 1976, and 1980. The impacts are fairly level as a percentage of income across the middle income levels, though they increase sharply as a percentage of income for low income families.

It is important to recognize that the distribution of impacts by income level is affected significantly by whether the direct cost of pollution control is paid for by industrial polluters, by the Federal government, by the State, or by the local community.

The following three figures show percent of family income affected versus income bracket, as represented by where a family falls on the percentile scale of income, lowest income being the zero or far left point of the scale. Figure VII-3 shows that pollution controls funded by Federal expenditures, because of the progressive nature of Federal income taxes, are relatively progressive -- that is to say they impact high-income families more severely as a percent of income than they do low-income families. Local expenditures have a very regressive impact, while State taxes are in between the Federal and local extremes.

The distribution of cost impacts (by income class) from increased electricity and automobile prices due to pollution control expenditures is shown in Table VII-1 and VII-2 respectively. The impact of other costs borne by private industry is shown in Table VII-3. Comparison of Figure VII-3 with Tables VII-1, VII-2, and VII-3 shows that pollution control expenditures made in the production of electricity and automobiles are more regressive than even local government expenditures; while expenditures made by industry related to production of other goods are about as regressive as local government expenditures.

In general, this points out the possibility that the costs of industrial pollution control, including that for public utilities and for automobiles, passed along to the buyer as a uniform price increase irrespective of the income bracket of the buyer could represent a more significant portion of the income of low-income families than they would for high-income families, causing the economic impact to fall more severely on a less capable segment of the population.

VII-3.a

TABLE VII-1
DISTRIBUTION OF INCREASES IN THE COST OF ELECTRICITY CONSUMED DIRECTLY BY RESIDENTIAL USERS

	1972			1976			1980	
FAMILY INCOME ($ thousands)	COST PER FAMILY UNIT ($)	COST AS % OF FAMILY INCOME	FAMILY INCOME ($ thousands)	COST PER FAMILY UNIT ($)	COST AS % OF FAMILY INCOME	FAMILY INCOME ($ thousands)	COST PER FAMILY UNIT ($)	COST AS % OF FAMILY INCOME
Under 2	1	0.05	Under 2.72	5	0.38	Under 3.56	8	0.48
2 - 4	1	0.03	2.72 - 5.44	11	0.21	3.56 - 7.12	15	0.27
4 - 6	1	0.02	5.44 - 8.16	12	0.15	7.12 - 10.68	19	0.21
6 - 8	1	0.02	8.16 - 10.88	12	0.13	10.68 - 14.24	21	0.17
8 - 10	1	0.01	10.88 - 13.60	11	0.10	14.24 - 17.80	24	0.15
10 - 15	1	0.01	13.60 - 20.40	17	0.10	17.80 - 26.70	27	0.12
15 - 20	2	0.01	20.40 - 27.20	18	0.08	26.70 - 35.60	37	0.12
20 - 26	2	0.01	27.20 - 35.36	25	0.08	35.60 - 46.28	48	0.12
26 - 50	3	0.01	35.36 - 68.00	32	0.07	46.28 - 89.00	66	0.11
Over 50	10	0.01	Over 68.00	40	0.03	Over 89.00	86	0.05

Based on cost estimates supplied by CEQ. Distribution based on data derived from Brookings Institution's MERGE file, using a 10 % sample.

VII-6

TABLE VII-2

DISTRIBUTION BY INCOME OF COSTS OF AUTOMOBILE EMISSION CONTROLS 1972, 1976 AND 1980

1972

Family Income[1] ($thousands)	Total Cost ($millions)				Cost per Family Unit($)[5]				Cost As % of Income[6]			
	Installation[2]	Catalyst Replace.[3]	Operating[4]	Total	Installation	Catalyst Replace.	Operating	Total	Installation	Catalyst Replace.	Operating	Total
0-2	8	-	6	14	2	-	2	4	.22	-	.17	.39
2-4	12	-	17	29	2	-	3	5	.07	-	.10	.16
4-6	27	-	40	67	3	-	5	8	.07	-	.10	.16
6-8	29	-	54	83	4	-	8	12	.06	-	.11	.17
8-10	37	-	74	111	5	-	11	16	.06	-	.12	.18
10-15	94	-	216	310	7	-	15	22	.05	-	.12	.18
15-20	62	-	194	256	7	-	22	29	.04	-	.13	.17
20-26	55	-	193	248	8	-	27	35	.04	-	.12	.16
26-50	59	-	219	278	10	-	36	45	.03	-	.11	.13
Over 50	8	-	44	52	6	-	34	40	.01	-	.03	.04
Total	390	-	1058	1448	6	-	15	21	.04	-	.11	.15

1976

($)												
0-2,720	70	19	19	108	18	5	5	28	1.37	.37	.37	2.12
-5,440	104	29	49	182	18	5	8	31	.42	.12	.20	.73
-8,160	244	67	118	429	29	8	14	50	.41	.11	.20	.73
-10,880	261	71	159	491	36	10	22	68	.38	.10	.23	.72
-13,600	331	90	218	639	45	12	30	87	.37	.10	.25	.72
-20,400	835	228	636	1699	56	15	43	114	.33	.09	.25	.68

VII-3a

TABLE VII-2 (Cont.)

(1976 Cont.)

Family Income 1/ ($)	Total Cost ($ millions)				Cost Per Family Unit ($) 5/				Cost As % of Income 6/			
	Instal-lation 2/	Catalyst Replace. 3/	Oper-ating 4/	Total	Instal-lation	Catalyst Replace.	Oper-ating	Total	Instal-lation	Catalyst Replace.	Oper-ating	Total
-27,200	557	152	570	1279	61	17	63	141	.26	.07	.27	.60
-35,600	487	133	567	1196	67	18	78	164	.22	.06	.25	.54
-68,000	522	143	645	1310	81	22	101	204	.18	.05	.22	.44
Over 68,000	70	19	131	220	52	14	97	162	.04	.01	.07	.12
Total	3480	950	3118	7548	48	13	43	105	.25	.07	.22	.54

1980

($)												
0-3,560	77	20	28	125	19	5	7	31	1.11	.29	.40	1.80
-7,120	116	30	76	222	19	5	12	36	.34	.09	.22	.65
-10,680	271	70	179	520	31	8	20	59	.34	.09	.23	.66
-14,240	291	75	242	608	39	10	32	81	.31	.08	.26	.65
-17,800	368	95	331	794	48	12	43	104	.30	.08	.27	.65
-26,700	930	240	965	2135	60	15	62	138	.27	.07	.28	.63
-35,600	620	160	866	1646	66	17	92	174	.21	.06	.30	.57
-46,280	542	140	861	1543	72	19	114	204	.18	.05	.28	.51
-89,000	581	150	979	1710	87	23	147	257	.14	.04	.24	.43
Over 89,000	77	20	199	296	55	14	141	210	.03	.01	.08	.12
Total	3874	1000	4730	9604	52	13	63	128	.20	.05	.25	.50

Detail may not add to totals due to rounding.

TABLE VII-3

DISTRIBUTION OF THE COSTS OF POLLUTION CONTROL
UNDERTAKEN BY PRIVATE INDUSTRY

Exclusive of increases in the cost of electricity consumed directly by residential users.

FAMILY INCOME ($ thousands)	1972 COST PER FAMILY UNIT ($)	COST AS % OF FAMILY INCOME	FAMILY INCOME ($ thousands)	1976 COST PER FAMILY UNIT ($)	COST AS % OF FAMILY INCOME	FAMILY INCOME ($ thousands)	1980 COST PER FAMILY UNIT ($)	COST AS % OF FAMILY INCOME
Under 2	4	0.40	Under 2.72	20	1.50	Under 3.56	27	1.56
2 - 4	5	0.18	2.72 - 5.44	26	0.66	3.56 - 7.12	36	0.68
4 - 6	7	0.14	5.44 - 8.16	39	0.55	7.12 - 10.68	54	0.57
6 - 8	10	0.13	8.16 - 10.88	45	0.50	10.68 - 14.24	63	0.52
8 - 10	11	0.12	10.88 - 13.60	58	0.48	14.24 - 17.80	81	0.49
10 - 15	14	0.12	13.60 - 20.40	77	0.46	17.80 - 26.70	99	0.47
15 - 20	23	0.13	20.40 - 27.20	116	0.49	26.70 - 35.60	152	0.50
20 - 26	29	0.13	27.20 - 35.36	148	0.49	35.60 - 46.28	206	0.51
26 - 50	41	0.12	35.36 - 68.00	206	0.46	46.28 - 89.00	278	0.47
Over 50	64	0.07	Over 68.00	328	0.25	Over 89.00	440	0.25

Based on cost estimates supplied by CEQ. Distribution by income brackets based on data derived from Brookings Institution's MERGE file, using a 10 % sample.

These observations on the income distribution effects of individual means of financing pollution control are probably more significant than information on distribution of the total costs, since information on the separate impacts provides a basis for making policy judgments on the incidence of future environmental legislation.

CHAPTER VIII

THE ENERGY IMPACT OF AIR POLLUTION CONTROL

The previous chapters discussed the levels of investment necessary to achieve environmental standards. This and the following two chapters discuss the energy implications of EPA programs. The general assumptions used in all three chapters are "conservative" so that the energy estimates should be considered to be at or near the upper limit of expected energy consumption due to environmental programs. The estimates tend to overstate the severity of the energy impacts for the following reasons:

- no technological improvements are assumed which might be less energy-consumptive
- pre-embargo fuel prices are used instead of current high prices. Low prices do not provide as much incentive to avoid energy consumption as do higher prices.
- no public trends toward small cars or toward other forms of energy conservation are assumed.

On the other hand, secondary effects, such as the energy used in manufacturing and transporting pollution control equipment and chemicals, have not been assessed. With the exception of chemical manufacturing for advanced waste treatment in sewage plants, the secondary effects have been estimated to be less than one tenth of the primary effects.

Hence, since these chapters attempt to portray a worst case analysis, subsequent changes in circumstances should result in even less energy consumption to achieve environmental standards than we predict. Recent data suggests that forecasts which EPA prepared earlier this year using similar assumptions overestimated the energy actually consumed by environmental programs. For example, the fuel economy of 1974 automobiles sold in all states except California improved by 2% to 3% over the same engine models used in 1973. This improvement is due entirely to engine design and tuning improvements which manufacturers made, based on their experience with 1973 automobiles under the same emission standard. EPA believes that it is reasonable to expect that many small changes will be made in future years which will further improve efficiencies and reduce energy penalties related to EPA's programs. However, such improvements are not assumed in this study.

This chapter discusses the energy impacts of the air pollution programs; Chapter IX is devoted to water programs; and Chapter X explains the positive energy impact of EPA's resource recovery programs. This chapter divides the agency's air pollution control program into two primary sections or emission categories -stationary sources and mobile sources.

Table VIII-1 summarizes the extra energy which these two air pollution abatement programs would require in 1980. The energy estimates are all expressed in thousands of barrels per day (MBD) of crude oil, although in many cases, coal, natural gas, or nuclear power are used as the energy source. The estimates are expressed as increments over 1968 energy use when there were very few environmental controls. Some EPA programs such as transportation control plans are designed so that they will reduce energy consumption. Energy savings, such as these, are listed in parentheses and are deducted from the total energy impact. For comparative purposes, the total consumption of energy by all users in 1980 as forecasted by the Project Independence Blueprint is the equivalent of 47 million barrels of crude oil per day.

TABLE VIII - 1

SUMMARY OF ENERGY IMPACT OF AIR POLLUTION CONTROL IN 1980

(Thousands of barrels per day)

Stationary Sources (total)		270
Electric Power Plants	145	
All Other	125	
Mobile Sources (total)		120
Auto Emission Controls	160	
Lead Free Regulations	60	
Low Lead Regulations	35	
Transportation Control Plans	(135)	
Total Energy Consumed		390 MBD

A. EPA's Clean Fuels Policy

The Clean Air Act establishes national ambient air quality standards to protect public health and secondary air quality standards to protect other values such as property and vegetation. In 1972, the States submitted Implementation Plans (SIP's) which included constant emission limitations to insure the attainment and maintenance of ambient air quality standards. The Act established a deadline for compliance for stationary sources by roughly mid-1975, with extensions possible through State initiative up to mid-1977.

More stack gas cleaning equipment and low sulfur fuel would be required to achieve the States' emission limits than can be made available. According to studies by EPA, FEA, and the BOM, the original State Implementation Plans (SIP's) would, in theory, have precluded the burning of 220 million tons of current coal production by 1975. However, through EPA's "Clean Fuels Policy" which was first promulgated in December 1972, States have been urged to relax limitations that were more stringent than necessary to protect public health. As a result, the deficit has been reduced to 185 million tons and changes currently in progress should reduce this deficit further to 130 million tons. Furthermore, EPA has pursued a policy of writing extended compliance schedules to assure that coal can continue to be burned. A second objective of the Clean Fuels Policy is to discourage conversion of power plants from coal to oil by relaxing sulfur limitations within limits dictated by ambient air standards. This policy reduces the incentives which coal-fired utilities may have previously had to convert to oil in order to meet sulfur standards.

B. Stationary Sources

Stationary sources can be divided into three groups -- electric power plants, industrial facilities and residential/commerical buildings. The major regulations affecting this overall category are of two types (1) New Source Performance Standards and (2) State Implementation Plans. Table VIII-2 divides the expected energy requirements in 1980 into these categories of environmental regulation.

TABLE VIII-2

STATIONARY SOURCE ENERGY IMPACTS

(Thousand of barrels per day)

	New Source Performance Standards	State Implementation Plans
Power Plants	55	90
Industry	25	55
Residential/Commercial	--	45
Total	80	190
Grand Total	270	

1. Electric Power Plants--The Clean Air Act requires that three pollutants from electric power plants be controlled--particulates, nitrogen oxides, and sulfur dioxide.

o Particulates are usually controlled by electrostatic precipitators or wet scrubbers. An average of about 0.1% of the power plant's generated energy is usually lost due to operation of precipitators. It is assumed that fossil fuel steam electric generating capacity is about 420,000 MW in 1980 and is operated at a 70% load factor. Approximately 35,000 barrels per day of crude oil (35 MBD) or its equivalent is needed to fire one thousand MW of generating capacity; so the total fuel penalty for particulate control is about 11 MBD in 1980.

o Nitrogen oxides are typically controlled by temperature limits on combustion and by operating procedures. The procedures can involve a fuel economy penalty because the optimal and most efficient operating condition of a boiler may not be at the point which minimizes nitrogen oxide emissions. There are no estimates of energy penalties for these controls, but they are expected to be very small. Flue gas treatment to reduce the emissions of nitrogen oxides is not practiced at this time because an acceptable technology has not been developed.

o Sulfur dioxide emissions can be controlled (1) by using fuels which contain very little sulfur in their raw state, (2) by desulfurizing fuels which contain too much sulfur, or (3) by desulfurizing the flue gases before they leave the stack.

Low sulfur fuel is the first alternative means of meeting sulfur standards. Natural gas is very low in sulfur content; and some forms of crude oil and coal have sulfur contents low enough to meet environmental requirements. Unfortunately, much of the coal found east of the Mississippi and many types of crude oil contain too much sulfur to be burned without some form of sulfur removal or control. Table VIII-3 indicates the proportions of coal used by electric utilities (1) which in their raw state meet new source performance standards (1.2 pounds of sulfur per million BTU); (2) which meet existing State Implementation Plans (varies from 3.2 to 6.0 pounds of sulfur per million BTU); or (3) which contain too much sulfur to meet either standard without some form of desulfurization.

TABLE VIII-3

STEAM COAL PRODUCED IN 1973

(million tons)

	Eastern States	Mid-Western States	Western States
Meets New Source Performance Stds	10.8	0.09	11.7
(Ratio of Reserves to Production)	(85)	(778)	(1538)
Meets SIP's	80.9	63.7	17.3
(Ratio of Reserves to Production)	(102)	(229)	(738)
High Sulfur Coal	98.5	71.1	0.1
(Ratio of Reserves to Production)	(132)	(730)	(very high)

Sources: Reserves - Mitre Corp., Survey of Coal Availabilities by Sulfur Content. May 1972.
Production - FPC Form 423, printout received by EPA July 19, 1974.

No equivalent analysis exists which would array the sources and sulfur contents of crude oils used in this country, but Table VIII-4 shows the sulfur levels of the residual fuel oil used in power plants. Most fuel oil sulfur specifications are now met by using naturally low sulfur crude and refining it into a mix of residual fuels of different sulfur contents, which are blended to meet standards. Fortunately, most domestic crude oil is naturally low in sulfur. Exceptions to that general rule are fields in West Texas and California. Crude oil imports also are usually low sulfur. For example, for the first six months of 1974, approximately two thirds of the crude oil imported was from nations having low sulfur oil fields.

Desulfurization of Fuels is the second alternative method to meet sulfur standards. Both coal and oil can be desulfurized -- coal by physical washing (removal of the pyrites) and by chemical processing, and oil by hydroprocessing. At the present time, chemical treatment of coal is too

TABLE VIII-4

SULFUR LEVELS OF RESIDUAL FUEL OIL CONSUMED IN POWER PLANTS

Average Percent Sulfur	Percent of Market	Weighed Percent Sulfur
.35	7.8	.027
.85	15.0	.127
1.25	22.5	.281
1.75	17.5	.306
2.50	32.0	.800
4.00	4.9	.196

Average % Sulfur 1.74

Source: Communication from James Porter, Associate Professor of Chemical Engineering, MIT; extracted from DOI Mineral Industry Surveys

IMPORTS OF CRUDE OIL BY SULFUR CONTENT

High Sulfur Nations		Amount Imported (million barrels)
Iran		88
Saudi Arabia		42
Venezuela		46
	Total	176
Low Sulfur Nations		
Algeria		21
Canada		152
Indonesia		49
Nigeria		106
	Total	328
Other Nations	Total	46

Source: DOI, Mineral Industry Surveys, June 1974.

expensive to be economic. Physical treatment of coal is done to a very limited extent at this time, but EPA estimates that by 1980 about 15 million tons per year will be able to meet standards because of physical washing. The energy penalty associated with washing is very small.

Chemical treatment of coal - gasification or liquefaction - solely in order to remove sulfur is not considered by EPA to be required or desirable. Chemical conversion requires that about 15-35% of the original energy be consumed in the conversion process; but it enables the resulting fuel--liquid or gas--to be used in many applications, such as household heating, where raw coal is unacceptable. In EPA's judgment, all future conversion projects will be designed primarily to supply high value fuel products or feedstocks or will be economic in their own right (combined cycle power plants). EPA supports research and development in these areas so that they can contribute to total energy supplies.

Desulfurization of fuel oils is commonly practiced at this time, but a fuel penalty of 2% for residual fuel and 1.5% for distillates is necessary (see Table VIII-5). Much present desulfurization is accomplished in order to upgrade a feedstock so that it can be processed into specific products. This desulfurization is not related to efforts to meet environmental standards. No accurate estimate exists which breaks out the proportion necessary for environmental standards from that used for in-refinery processing.

EPA believes that the amount of residual fuel oil used in power plants which would require desulfurization in 1980 is between 500 MBD and 1000 MBD. This assumes that the average sulfur content of the fuel actually processed is reduced from 3.0% sulfur input to 0.3% sulfur output. The energy penalty of this requirement is between 10 and 20 MBD.

This estimate is derived from the following assumptions and data:

TABLE VIII-5

ENERGY REQUIREMENTS FOR OIL DESULFURIZATION

Requirements	Destillates	Residual Fuel
Heat (BTU per barrel)	55,000	64,000
Steam (pounds per barrel)	6	2.7
(BTU per barrel)	6,000	2,700
Electricity (KWH per barrel)	1.7	4.4
(BTU per barrel)	18,000	46,000
Total BTU per barrel	79,000	113,000

Source: Hydrocarbon Processing, 1970 Refining Processes Handbook, vol 49(9), pp. 163-274, 1970.

TABLE VIII-6

ASSUMED DESULFURIZATION REQUIREMENTS

	1974	1980
Total oil-fired electric capacity*	65,000 MW	110,000 MW
Residual fuel required	1,600 MBD	2,700 MBD
Average sulfur content before desulf.	2.25%	2.50%
Average sulfur content required	1.75%	1.50%
Amount desulfurized	300 MBD	1,000 MBD
Fuel Penalty	6 MBD	20 MBD

Sources: * DOI Forecast, Energy Through the Year 2000, 1972. The FPC has estimated that oil-fired capacity in 1980 would more likely be about 85,000 MW.

The President's recently announced program to convert at least one million barrels per day of oil-burning base load capacity to coal or nuclear fuel by 1980 could change the assumptions so that only about 60,000 MW of electrical capacity would be oil fired in 1980. EPA conservatively assumes that this remaining capacity would generally require very low-sulfur oil (perhaps about 1.0% average because many plants would be in areas where ambient sulfur levels are high), but that the average sulfur content of the crude oil from which it comes will be about 2.0%. Given these assumptions, about 720 MBD of fuel oil would require desulfurization, and the energy penalty would be reduced from the 20 MBD before conversion to about 15 MBD. However, any increased requirements for stack gas desulfurization on coal fired power plants due to this program would increase energy used for pollution control because stack gas scrubbing requires a larger energy penalty per unit of electricity generated than does desulfurization.

Stack gas desulfurization is the third alternative to achieve ambient air quality standards. This technology is used when low sulfur fuels cannot be supplied at an economical price. Flue gas desulfurization is now used on 3300 MW of installed electrical generating capacity at 19 different power plants. Flue gas desulfurization for seventy-four other units totalling 35,400 MW of capacity is under construction or planned. EPA estimates that stack gas scrubbers will be used on about 90,000 MW installed capacity--about 20% of the total fossil fuel capacity by 1980.

This estimate, and the energy penalty which would result, is derived from the following assumptions and data:

Table VIII-7
Estimate of Stack Gas Cleaning Energy Penalty

1980 Fossil Fuel Capacity	420,000 MW
1980 Coal Fired Capacity	340,000 MW
1980 Utilities Using Conforming Coal (existing mines)	150,000 MW
1980 Utilities Using Conforming Coal (new mines)	100,000 MW
1980 Utilities Using Stack Gas Cleaning*	90,000 MW
Estimated Energy Penalty of SGC	5% of input
Estimated Coal Quality	3.0 - 3.5% S
Load Factor	70%
Computed Total Penalty at 35MBD per 1000 MW	3150 MW 110 MBD
Percent of Total Installed Fossil Fuel Capacity	0.7%

*source: FPC 1974 National Power Survey

The President's program could result in as much as 25,000 MW of installed oil-fired (or gas-fired) being converted to coal. A significant proportion of these plants could require stringent sulfur limitations and might require stack gas scrubbing. Secondly, the program should ensure that about 7,500 MW of planned new oil-fired capacity will instead rely on coal. Some of these plants could also require significant sulfur limitations because most present or planned oil burning capacity is in coastal regions where ambient sulfur levels can be critical. EPA has no analysis of these factors, but if about 20,000 MW of this total new coal-fired capacity required scrubbing, then the total energy penalty in 1980 would be 135 MBD. The estimate is calculated from the same assumptions as appeared in Table VIII-7.

The total fuel penalty for power plants to meet air pollution standards is the sum of the penalties for particulate control (up to 15 MBD), for fuel oil desulfurization (20 MBD) and for flue gas desulfurization (110 MBD). The total is 145 MBD for air pollution control.

2. Industrial and Residential/Commercial Sectors - It is estimated that the industrial sector will require a fuel penalty of about 25 MBD to meet special air emission requirements--primarily to meet new source performance standards. Many of the emissions and control processes are unique to specific industries and are designed to abate specific types of emissions. No in-depth analysis exists for this estimate.

   State Implementation Plans to meet ambient air quality standards for sulfur dioxide will be met by both the industrial and the residential/commercial sectors using much the same combination of alternatives as were used by the utility sector, except that stack gas scrubbing will be appropriate for only a few industries. EPA assumes that about 500 MBD of residual fuel and 3500 MBD of distillates for the industrial sector would require desulfurization in 1980. These estimates are derived from approximately the same analysis as was presented on the previous pages for utilities. The penalty for the industrial sector to meet SIP limits is estimated to be about 55 MBD (10 MBD for residual fuel and 45 MBD for distillates).

The residential and commercial sectors together will require about 3500 MBD of distillates to be desulfurized in order to meet state implementation plans. The penalty will be about 45 MBD.

Table VIII-8

Sector	NSPS	SIP's	Total
Industrial	25 MBD	55 MBD	80 MBD
Residential/Commercial	--	45 MBD	45 MBD
		Total	125 MBD

C. Mobile Sources

The Clean Air Act has mandated specific emission standards for automobiles. These standards must be attained in 1977 and 1978. Attainment of the standards with present technology requires a trade off either in cost, engine performance, or fuel economy. Before the oil embargo, the auto industry allowed engine fuel economy to deteriorate, in part due to emission standards; however, now higher energy costs are encouraging the industry to rely to a greater extent on advanced technology and higher auto costs in order to meet emission standards.

1. Fuel Economy Estimates - In March 1974, estimates were developed by EPA which indicated that the fuel penalty in 1980 of automobile emission standards would be about 435 MBD. This estimate was overly conservative because it projected no improvement in the state-of-the art of engine technology between January 1974 and 1980. Two key assumptions were made: (1) imposition of statutory standards would require fuel-consumptive technology and (2) no improvements would be made in engine performance during the second or third model years under any given standard. Since March 1974, new information has been developed by the industry and by EPA which indicates that both assumptions were too pessimistic. It seems now that domestic manufacturers will probably choose to meet statutory standards with a mix of new fuel-efficient emission abatement systems which were not fully foreseen six months ago.

Emission control will therefore be comparatively less energy consumptive than was expected.

Secondly, new data on 1974 automobiles indicates that on the average, engine fuel efficiency for all cars except those in California improved by about 2% to 3% over the same cars in the 1973 model year. Accordingly, the March 1974 projections have been modified to reflect more current information, specifically the DOT-EPA report. The revised assumptions listed below are considered conservative but realistic. It's probable that actual engine efficiencies will be even higher than those which are now predicted. It is, however, unlikely that the ultimate efficiencies will be below this revised estimate.

EPA now predicts that the average fuel economy of engines manufactured from this point on--starting with the 1975 cars now under production--will not have a fuel penalty compared with engines built before emission controls were installed (1957-1967). The efficiency of 1975 model year cars will on the average be about 13.5 miles per gallon, a gain of about 9% over 1974 model year cars and about the same as 1968 model year cars. The EPA/DOT Report estimates that in subsequent years, considerable potential exists for fuel economy above the 1975 level, but a conservative estimate is that 1975 fuel economy will be maintained in subsequent years.

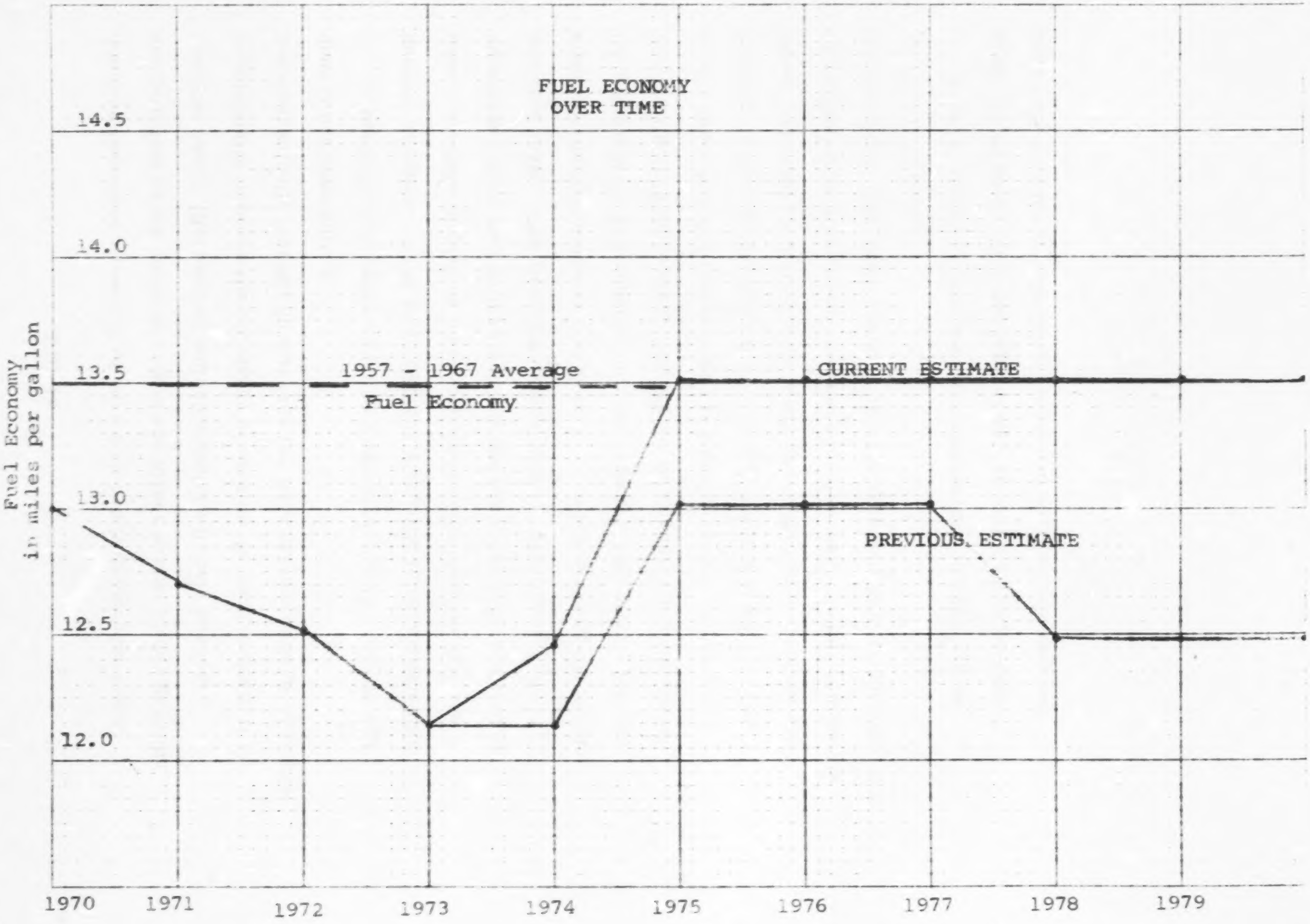
This analysis does not assert that emission controls provide an energy benefit. In the absence of emission controls, or given less stringent standards, the same or better fuel economy could be attained at less financial cost.

Conversely, it is possible that some technologies which are installed to meet emission limits, and which also provide fuel economy benefits, would not be installed if it were not due to emission limits. The important point is that emission limits can induce the industry into installing fuel-efficient equipment such as high energy ignition systems and improved carburetion, which they might not otherwise find cost-effective and might not install purely in the interest of fuel economy.

Figure VIII-9 is an illustrative diagram of the 1957-1967 fuel economy benchmark and two predictions of future fuel economies--the prediction made last March and the current prediction. Both forecasts are compared with the efficiency of an uncontrolled car (pre-1968). The current prediction corresponds to the lowest estimates which were developed in the DOT-EPA study.

Actual fuel economy performance declined until 1973. In 1973, performance due solely to emission controls was 10% below that of the 1957-1967 average, primarily because many automobile manufacturers met standards by changing the operating conditions, timing, and compression ratios of their engines. This approach met the interim emission standards but detracted from performance. In 1975, performance will improve considerably because the burden of emission control has been shifted from engine adjustments to the catalytic converter. Engines for this model year operate at or near their 1967 efficiency. If, however, all current emission limits were removed, efficiency of future cars

FIGURE VIII-9



could be improved above that of cars with catalysts because engine compression ratios could be raised and higher octane leaded gasoline could be used. (Removal of emission limits will not, however, substantially improve the efficiency of cars on the road because it is not economically feasible to increase the compression ratio of an engine once it has been built.)

In the 1977 model year, statutory standards for HC and CO will become effective. Attainment of these standards is not expected to pose a problem insofar as fuel economy is concerned because the standards can be met with essentially the same catalytic systems as are used today. The DOT-EPA study states, "Significant fuel economy improvements are feasible....... while meeting the HC and CO standards." The report continues, however, by stating that the level of the 1978 model year NOx emission standards is unresolved at this time, but that fuel economy is expected to be, in part, a function of that standard and the technology used to attain it. This paper makes no prediction about whether the 1978 NOx standard will be relaxed from its present statutory level or not. To be consistently conservative, this paper assumes that the statutory NOx standard (of 0.4 gm/mi) is imposed.

In 1978, the auto manufacturers can respond in two ways to meet the statutory NOx standards: they can sacrifice some fuel efficiency with lower cost emission control systems, or they can maintain efficiency levels by installing a mix of more expensive control technologies. Last March, EPA assumed that they would sacrifice efficiency because at the time there seemed no feasible alternative. In the last six months, however, more-sophisticated catalytic reactors and proportional exhaust gas recirculation equipment have been refined by at least two domestic manufacturers. Recent preliminary tests of alternative control systems have been satisfactory and EPA feels that it may now be possible for most auto manufacturers to meet emission standards without reducing efficiency. This possibility depends in part on the economic trade-off between first cost and fuel costs.

The recent test data indicate that new dual catalysts and the proportional exhaust gas recirculation systems are very effective methods not only to meet standards, but also to maintain fuel economy. (Fuel Economy of the 1975 Models, by Austin and Hellman, EPA, Society of Automotive Engineers, Paper No. 740970, October 1974, and Durability Experience with Metallic NOx Catalysts, by Fedor, et. al., Gould, Inc., Society of Automotive Engineers, Paper No. 741081, October 1974.) For example, some GM data indicate an increase in economy of 6% with the 15% PEGR needed to meet statutory standards (Optimizing Engine Parameters with EGR, by Gumbleton, Bolton, and Lang of General Motors Corp., Society of Automotive Engineers, February 25, 1974). EPA's position is that although it is clear that the technology is available to meet standards, a sufficiently strong case has not yet been made to prove that the GM system can also be both economically reasonable and improve fuel economy. However, it does seem as if the weight of evidence is shifting so that it is more reasonable to assume general adoption of more fuel-efficient systems in future years. Therefore, until better and more conclusive data are available, EPA in this analysis projects the energy impact under the conservative assumption that fuel economy remains constant and does not improve between now and 1980.

This projection also assumes that the mix of large and small cars will remain the same in the future as in 1973 (about 60% large and 40% small) and that average automotive weight will be constant. Both assumptions are very conservative because the actual model mix has shifted toward small cars and many manufacturers have significantly reduced the average weight of their cars.

The forecast in this paper cannot be compared with data in the DOT-EPA study because the assumptions about model mix and engine sizes are different. For example, this projection conservatively predicts only a 9% fuel economy improvement in 1975 over 1974. The DOT-EPA study, however, assumed that a preference for small cars over larger ones continues and that the average vehicle weight (as determined by the production mix) continues to decline throughout the model year. Under those assumptions, the sales weighted fuel economy for MY 1975 will be about 13.5% better than 1974, based on certification test data of the new cars. Table VIII-10 presents the fuel economy data used in this analysis for each manufacturer.

Therefore, the energy penalties due to emission controls which have been computed in this report assume that the statutory standard is met in 1978, although the Administrator of EPA has recommended that the standard could be reduced for 1978. Furthermore, they assume that the technologies which have been recently developed to control NOx emissions will be available in 1978 in sufficient quantities so that no overall fuel penalties will result. This assumption about availability of the control devices may be optimistic, but it is considered reasonable because of the importance being placed by the industry on automotive fuel economy.

TABLE VIII- 10

1975 Fuel Economy Data

Manufacturer	Years	Fuel Economy	Total Improvement	Improvement Due to Emission System	Improvement Due to Model Mix
General Motors	1974	10.5mpg			
	1975	13.5	28.1%	28.3%	-0.2%
Ford	1974	12.4			
	1975	11.5	-7.9	-2.2	-5.7
Chrysler	1974	11.9			
	1975	13.6	14.7	12.1	2.6
AMC	1974	14.5			
	1975	16.9	16.8	20.5	-3.7
VW	1974	22.2			
	1975	22.9	2.8	3.8	-1.0

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TABLE VIII-II

1980 Fuel Consumption

MODEL YEAR	INITIAL SALES ($x10^5$)	SURVIVAL FACTOR	NO. OF CARS ON ROAD ($x10^6$)	AVG. NO. OF MILES $x10^3$	VMT ($x10^4$)	FUEL ECONOMY	TOTAL GASOLINE (10^9)
65-67	26.0	.07	1.82	3.0	5.46	13.5	0.40
68	10.5	.20	2.10	5.5	11.55	12.94	0.89
69	10.6	.33	3.50	6.0	21.00	12.70	1.65
70	9.4	.46	4.32	6.5	28.08	13.01	2.16
71	10.9	.59	6.43	8.0	51.44	12.70	4.05
72	11.3	.74	8.36	8.3	69.39	12.51	5.55
73	11.8	.85	10.03	8.6	86.26	12.14	7.11
74	10.7	.91	9.74	10.0	97.40	12.46	7.81
75	10.9	.96	10.46	10.3	107.74	13.51	7.97
76	11.7	.98	10.93	11.4	125.17	13.51	9.[illegible]7
77	11.5	.99	11.39	11.7	133.20	13.51	9.87
78	11.7	.99	11.58	13.2	152.90	13.5[illegible]	11.3[illegible]
79	12.0	1.00	12.00	16.1	193.20	13.51	14.30
80	12.2	1.00	12.20	10.1	123.22	13.51	9.13
			114.91		1206.01		91.66

Total gasoline required by controlled cars = 91.66 billion gallons

Total gasoline required by uncontrolled cars = 89.34 billion gallons

Difference (billion gallons per year) = 2.32
(thousand barrels per day) = 152

Plus loss in refining of 5.6% = 160 MBD

For years beyond 1978, the Agency feels that average fuel economy will improve unless the price of gasoline decreases substantially. No improvement, however, is assumed in this forecast.

The following table presents the details behind the EPA estimates which were compiled under these key assumptions.

Assumptions:

- o 1975 interim standards are maintained through 1976 model year
- o Statutory HC and CO standards are adopted for the 1977 model year
- o The NOx standard is set at 0.4 gm/mi for the 1978 model year onward
- o No improvement in technology over that foreseen at this time; however, electronic ignition systems, improved carburetion and proportional exhaust gas recirculation will be installed on most cars in or by 1977 model year as an essential part of the emission control system.
- o Model mix of small and large cars remains the same as during 1973; (e.g., 60% large and 40% small cars).
- o No fuel economy legislation or regulations are adopted
- o No alternative engine technologies are introduced in significant numbers before 1980
- o No deterioration in engine efficiency or fuel economy with age of cars.

- Model year sales figures are actual (1967-1973) or estimated using DOT-FHWA projections
- 1975 FTP fuel economy figures used throughout
- Refining loss = 5.6% of original BTU in crude oil
- Average number of miles travelled per year by age of car remains constant. Source of travel distribution: Federal Highway Administration, DOT, Nationwide Personal Transportation Study, Report No. 2, April 1972.
- Survival factors (percent of cars by model year remaining in use in subject year) obtained from 1972 Automobile Facts and Figures, Motor Vehicle Manufacturers Association of the U.S., Inc., p. 31.

EPA-DOT Task Force

The joint EPA-DOT Task Force mandated by Congress to study fuel economy has made less restrictive assumptions than this report and has attempted to predict the most probable mix and technologies of future cars, rather than a lower bound as this forecast intends.

Improvements considered by the Task Force are also not limited to the drive train (i.e., they take into account average weight, model mix, radial tires, etc.). Whereas the conservative assumptions used in this analysis predict a minimum fuel economy of 13.5 mpg for 1980 cars, the Task Force predicts fuel economies of between 15 and 27 mpg. EPA believes that the Task Force estimate is likely to be accurate, but that the estimate takes credit for improvements that are not attributable to emission controls

EPA-DOT

WEIGHTED URBAN - HIGHWAY 1980 FUEL ECONOMY (MPG)

Class	1974	1980
Sub-compacts	21.5	27.0
Compacts	16.1	21.1
Intermediates	11.4	16.1
Standard	11.2	16.1
Luxury	10.1	14.9

2. Leaded Gasoline Regulations

Control of pollution from mobile sources involves energy penalties that affect more than automobiles. Gasoline production in refineries has also been affected because the gasoline specifications have been changed to accommodate pollution controls on new cars. The impacts on gasoline production stem from the following:

a. Automotive engine compression ratios were reduced in 1971 in order to reduce NOx emissions and use lower octane gasoline in anticipation of future limitations on lead content in gasoline.

b. Catalysts require lead-free gasoline.

c. Refineries can generally make only a relatively low-octane lead-free gasoline.

d. EPA published regulations which require certain gasoline stations to supply lead-free gasoline.

e. Since lead emissions are themselves hazardous to health, EPA published a phasedown schedule which reduces the average content of lead in all gasoline sold.

As the situation now stands, there are two complementary EPA regulations on the books. The first is designed to ensure an adequate supply of lead-free gasoline for catalyst-equipped automobiles. The second regulation reduces the maximum amount of lead which can be emitted into the atmosphere by about 65% over the next five years so that the health hazard can be reduced. The regulations are called the "lead-free" and the "low-lead" regulations respectively.

Since refineries usually use lead to increase the octane of gasoline, the regulations tend to force them to use other means of processing to attain their specifications. Increased downstream processing--primarily alkylation, and hydrocracking--will require more energy in the refining process, and it can cause some short term changes in the mix of products which any particular refinery has traditionally supplied.

In the short term, much of the energy penalty is due primarily to refinery dislocations. In the long term, the penalty becomes the extra refinery fuel required to upgrade the octane of the gasoline.

Two studies have been done for EPA on this subject, and are summarized below. The contractors were Bonner and Moore Associates and Arthur D. Little.

Table VIII-13

Year	Average Lead in all Gasoline (gm/gal)	Energy Penalty (MBD)	
		Bonner & Moore	ADL
1975	1.7	60	2 Lead Free
		20	2 Low Lead
		80	4 Total
1977	1.0	45	40-64 Lead Free
		40	48-58 Low Lead
		115	88-122 Total
1980	0.5	75	64-40 Lead Free
		20	58-48 Low Lead
		95	122-88 Total

The Bonner and Moore study is entitled Economic Impact of Lead Removal from Motor Gasoline, July 27, 1973. The ADL study is the Impact of Motor Gasoline Lead Additive Regulations on Petroleum Refineries and Energy Resources--1974-1980, and was published in May 1974. The ADL study differed from Bonner and Moore study for

1975 because it used newer data. Its estimates for 1977 and 1980 varied in the range given above, with the total impact in 1977 likely to be slightly over 100 MBD and the impact in 1980 likely to be somewhat under 100 MBD.

A pertinent point is that fuel economy savings resulting from the catalyst more than compensate for the penalty resulting from lead-free gasoline for use in catalytic converter-equipped cars.

In addition, the catalyst can be said to nullify the loss of efficiency ascribed to decompression of automobile engines in order to make them accept low-lead or lead-free gasoline. The penalty associated with decompression has been included in that of the previous section. Of the 270 MBD penalty due to emission controls in 1974, about 95 MBD was due to decompression. In 1980, the decompression penalty will be about 50 MBD.

Various alternative lead-tolerant technologies have come under consideration by the auto industry in order to increase fuel economy, meet emission standards, and avoid a requirement for lead-free gasoline. Manufacturers have chosen to use catalysts to meet the 1975 interim standards, but may use other types of reactors or advanced technology in subsequent model years. The best current information indicates that the rich and lean thermal reactor systems being tested do not exhibit better fuel economy than the catalyst despite higher compression ratios. On the other hand,engine types that might achieve better fuel economy are the diesel and stratified charge A switch by the auto industry to the diesel would likely require a major reallocation of investment in the refinery industry since most existing refineries are designed to make gasoline, however the switch would insure substantial energy economies. The stratified charge engine holds great promise but a fuel-efficient production model has not yet been developed for the larger engine sizes.

3. Transportation Controls

EPA's program to attain air quality standards for the key pollutants emitted from mobile sources has been focusing on other alternatives in addition to direct emission reduction from automobiles since auto emission reductions will not be enough to bring air quality in a number of cities to the level required by the health-related ambient standards. One program seeks to reduce the total vehicle miles travelled by automobiles and the emissions from gasoline in service stations and to ensure through inspection and maintenance programs that vehicles continue to be operated at maximum efficiency. This program of transportation control plans concentrates its efforts on the few municipalities with significant air quality problems and includes incentives to encourage car-pooling, mass-transit, and more efficient transportation networks.

The total fuel savings attributable to transportation control has been computed to be 100 MBD in 1977 and 105 MBD in 1980 due to the reductions required in vehicle miles travelled, and about 30 MBD due to gasoline vapor controls from service stations. Gasoline vapor controls save slightly less than 0.5% of total gasoline station volumes. Inspection and maintenance programs can improve fuel economy of some vehicles up to an average of 6%; however, no estimate of total fuel savings is available for this measure.

Transportation control plans have been developed, and are now being implemented in 26 cities. For example, in Boston implementation of the control measures is expected to result in a planned fuel savings of approximately 110 million gallons of gasoline each year (7.6 MBD) for that metropolitan area. The Boston program relies primarily on an extensive employer transit incentive program.

Summary - Mobile Sources

The energy impacts of the mobile source pollution reduction programs now and in 1980 are summarized in the table below.

Table VIII-14

ENERGY IMPACT OF AIR POLLUTION CONTROL FROM MOBILE SOURCES

Program	Penalty or Benefit	
	1974	1980
Auto Emission Controls	270	160
Lead Free Regulations	20	60
Low Lead Regulations	0	35
Transportation Control Benefit	0	(135)
Total	290	120

It should be emphasized that these impacts are based on very pessimistic assumptions which were used so that the energy impact could be isolated and estimated under conditions in which no other factor would change. The DOT-EPA study was not bound by these constraints and assumed that automotive systems would adjust to new circumstances. Under those assumptions, which EPA considers realistic, there will probably be no energy penalty for emission controls in 1980.

CHAPTER IX

ENERGY IMPACTS OF WATER POLLUTION CONTROL

Water pollution abatement programs affecting energy are divided into two major parts--municipal wastewater treatment and the control of industrial wastewater pollution. This chapter assesses the energy requirements of these programs. The assumptions about energy requirements which are used throughout this chapter are designed to be conservative. In reality, EPA expects the energy penalty to be somewhat lower than this prediction.

Underlying the analysis are three conservative assumptions:

- No new technologies are used which would be more energy-efficient than those currently in use.
- Energy prices are low (pre-embargo level) so that the incentive to save money by reducing energy consumption is minimal.
- There is no explicit Federal energy conservation program.

In reality, there is a clear national trend, especially in the industrial sector, toward water conservation and water resource recovery. Since water treatment costs and energy use are a strong function of the quality of water treated, any movement toward water conservation, effluent segregation, and/or water reuse will tend to reduce treatment costs and energy consumption. EPA therefore feels that the following estimates of energy demands are about at the upper limit of future energy consumption.

A. Municipal Wastewater Treatment

Sewage treatment is not an energy-intensive process. However, because there are large quantities of sewage to be treated, demands for fuel or electricity can become significant on a national scale. The following assumptions were used to generate estimates of national requirements for energy by wastewater treatment plants:

1. Secondary treatment will be required at all plants by 1980.
2. No more than 10% of all sludge is incinerated. The balance is land-filled or used for fertilizer (84% of all present plants use land disposal).
3. Activated sludge treatment is utilized to attain secondary standards.
4. Advanced waste treatment is required for about half the plants which are on heavily polluted streams.

In accordance with the assumptions, the energy consumed by all municipal wastewater treatment plants and the amount of energy expected to be required by FWPCA are summarized below. Table IX-1 also differentiates between energy required to meet the "best practicable treatment" guideline (secondary treatment) and advanced treatment which will be required in certain cases.

Table IX-1

Year	Level of Treatment	Energy Use (MBD)	Total Energy
1968	All levels of treatment	13	13
1974	All levels of treatment	20	20
1977	Best practicable treatment	20	
	Advanced treatment	6	26
1980	Best practicable treatment	24	
	Advanced treatment	20	44

Not included in this tabulation are energy requirements for (1) construction of treatment plants, (2) manufacturing of new equipment, (3) nonprocess related energy demand such as space heating for the laboratory buildings, (4) collection system pumping requirements or (5) manufacturing of chemicals used in processes, especially for advanced treatment processes.

On the other hand, this analysis also did not include energy recovery by collection of methane during the treatment process. Methane collection has not been extensive in recent years because alternative sources of energy were very cheap. However, current energy prices will again make methane collection cost-effective, and it will supply a significant percentage of energy needs for these facilities.

Energy demand for treatment increases very rapidly as effluent standards become more stringent. This estimate assumes that the solids are processed by digestion, and dewatered by vacuum filtration followed by landfill or agricultural disposal.

Energy demand can vary significantly from one plant to the next depending on specific plant types and designs. The assumptions made in this evaluation have been chosen to best represent typical plants which have demonstrated the capabilities of meeting the minimum effluent limitations.

Table IX-2

Energy Requirements for Representative Treatment

Treatment Process	Flow (MGD)	Energy Demand (in KWH/Day)
Primary	10	1,500
	100	4,500
Secondary	10	5,000
	100	22,000
Advanced	1	4-10,000
	10	12-28,000
	100	40-150,000

(Source: Battelle Memorial Institute)

The 1968 inventory of all municipal waste treatment facilities which was used as a basis for the estimates is summarized in Table IX-3. The energy requirements for primary and secondary facilities were multiplied by the number of plants and the total flow for plants in each size category.

The 1974 estimate was computed by adding all new projects to the 1968 inventory. The estimated energy demand in 1974 is 11.4×10^6 kwh/day or 20 MBD.

Table IX-3

Distribution of Sewage Treatment

	Population Served	kwh/day capita	Total kwh/day
Minor Treatment	1,360,870	.0185	25,175
Primary Treatment	36,947,397	.0286	1,056,656
Intermediate Treatment	5,857,690	.0286	167,530
Activated Sludge	41,264,036	.113	4,662,636
Trickling Filters	29,617,136	.043	1,273,537
Ponds	6,123,078	.0135	82,662
Other and Unknown	8,636,514	.0135	116,593
Tertiary Treatment	325,530	.226	73,570
TOTALS (1968)	130,132,251		7,458,359 (13 MBD)

The estimate obtained for 1974 has been adjusted upwards by 11 percent to account for growth in sewered population between 1974 and 1977 and the impact of the requirement for secondary treatment has been added. From these assumptions, the estimated energy demand for achieving secondary treatment is 16.8×10^6 kwh/day (29 MBD). Because of delays in funding, much of the actual energy impact of total secondary treatment is assumed in this analysis to be delayed until 1978 instead of 1977. The difference between the predicted 1978 energy use (29 MBD) and 1980 energy use (44 MBD) will be almost entirely for advanced waste treatment.

EPA's best estimate is that by the mid-1980's between 75 and 80% of the energy requirement for municipal treatment will be for advanced treatment. The total then required for advanced plus secondary treatment will be about 105 MBD if water quality goals are met on all streams.

B. Effluent Guidelines for Power Plants

The FWPCA requires that all industrial discharges provide "best practicable treatment" by 1977 and "best available treatment" by 1983. These technology-based standards are being promulgated by EPA as effluent guidelines for all major industrial categories.

Table IX-4

1980 Energy Penalty of Effluent Guidelines

Electrical Power Plants	
Cooling of Thermal Discharge	50 MBD
Chemical Treatment	negligible
Other Industries	
Cooling of Thermal Discharge	negligible
Effluent Treatment	40 MBD
TOTAL	90 MBD

The FWPCA requires EPA to promulgate effluent limitations for steam-electric power plants. These limitations will require many existing and proposed power plants to provide off-stream cooling, with an attendant energy penalty due to reduced efficiency and increased operating requirements. A conservative estimate of the 1980 energy penalty is 50 MBD.

Assuming that the total steam-electric generating capacity, including nuclear power plants, in 1980 is about 530,000 MW, EPA estimates that about 70,000 MW will require closed-cycle cooling to meet the effluent guidelines after consideration of exemptions under Section 316(a) of the FWPCA. Assumption include:

- o Thermal limitations will cover units larger than 500,000 kilowatts that were placed in operation after January 1, 1970, and all units larger than 25,000 kilowatts placed in operation after January 1, 1974. The affected units must comply by 1981, with extensions available up to 1983 for reliability considerations (except for those receiving a Section 316 exemption for 10 years).
- o A 3% annual fuel penalty was assumed.
- o 50% of future units for which utilities are planning to install cooling towers are doing so for economic reasons and therefore are not included in the energy penalty. (Source: EPA estimates)
- o Energy penalties will be divided between coal and oil in accordance with their projected mix in the 1979-1983 period --- 80% coal, 20% oil.

C. Effluent Guidelines for All Other Industries

These regulations will be in effect by 1977 but the total energy impact will not be felt until 1983. Effluent guidelines for industries other than electric power have been tentatively estimated, based on projected requirements for heating fuel and electricity which have been developed by consultants during their examination of alternative control technologies to meet effluent guidelines. These estimates are preliminary, but existing data indicate that the effluent guidelines will require an energy penalty of approximately 70 MBD in 1983. It is estimated that in 1980 the penalty will be 40 MBD. These estimates are based on flow rates and treatment requirements for each of the industries for which an effluent guideline has been promulgated. Future effluent guidelines for additional industrial categories could to increase this estimate significantly.

CHAPTER X

RESOURCE RECOVERY AND ENERGY SUPPLY

EPA's on-going program to improve the management of municipal solid waste programs is designed primarily to improve the environment, but it also has significant energy benefits which counterbalance, to some extent, the energy penalties of EPA's air and water programs.

Concern about energy supplies during the Arab embargo focused attention on how natural resources are used and on the potential to save energy by reducing waste. Continued growth in the consumption of raw materials and in the generation of solid wastes--with their attendant use and waste of energy--is neither inevitable nor necessary. Significant amounts of energy could be conserved by improving upon current materials use and waste management practices. This chapter discusses three opportunities to conserve through better solid waste management:

1. Source Reduction	Reducing consumption of products or reusing products, resulting in the use of less energy and materials and in reduced waste generation
2. Energy Recovery	Using solid waste as a fuel in place of coal, oil or gas; primarily to fire power plants.
3. Recycling	Using recycled materials that consume less energy than virgin materials in manufacturing processes.

When considering the combination of these three resource recovery measures, the total energy benefits from improved solid waste management cannot be determined by adding the potential savings from each category listed above because the three areas are interrelated: energy saved in one area may reduce the potential for savings in another. For example, banning non-refillable beverage containers (a source reduction measure) will reduce the amount of waste material available for recycling. Recycling combustible materials such as paper will reduce the amount of waste available for energy recovery.

On the other hand, some resource recovery measures will support or encourage other resource recovery measures. For example, energy recovery by combustion of organic material is very compatible with recycling of inorganic (noncombustible) materials, because energy recovery systems improve the economics of materials recycling. In an energy recovery system, the noncombustible recyclable materials are typically separated from the mixed waste even if they are not going to be recycled. The additional cost of removing the recyclable materials appears to be more than offset by the additional revenues from the sale of those materials. Table X-1 describes the maximun possible energy savings from resource recovery and EPA's estimate of savings if current trends continue.

Table X-1
Resource Recovery

Program	Maximum Energy Savings		EPA's Estimate	
	1974	1980	1974	1980
1. Source Reduction	115	150	0	0
2. Energy Recovery (Combustion)	335	460	0	65
3. Recycling	45	60	0	35
Total	515	670		100

Currently, of course, very little of this potential is actually recovered. In fact, a pilot operation only recently was started in St. Louis which would consume municipal garbage and refuse. Until that time energy recovery by combustion, the largest of the above categories, had not been exploited.

A. Source Reduction

If consumption of packaging in 1980 were reduced to the per capita levels that existed in 1958, a potential of approximately 550 MBD could be saved. If beverage containers were recycled an average of ten times before they were destroyed, about 200 MBD could be saved in 1980.

Although national implementation of either measure is unlikely in the absence of Federal legislation in this area, higher resource prices are making packaging more expensive and recovery of materials more desirable. However, EPA has no reliable estimate for the amount of packaging which will be foregone because of higher resource costs.

B. Energy Recovery by Combustion of Waste

About 70 to 80 percent of all residential and commercial waste is combustible and has an energy content averaging 9 million BTU per ton (compared to 25 million BTU per ton of coal or 4.5 million BTU per ton of oil shale).

Modern waste collection systems can easily segregate most of the organic waste so that its resource potential can be exploited. Depending on the waste characteristics, it can be composted, converted into organic chemicals, or burned. EPA believes that in the short run the most feasible alternative for organic waste will be to burn it in power plants, either alone or in combination with coal. Table X-2 shows the total potential amount of organic waste that is generated and the amount which could be economically recovered.

Table X-2

	Recovered Energy (in MBD)	
	1971	1980
Total Potential	522	680
Economically Available	393	512
Potential from 35 candidate communities	0	263
Energy from actual projects under construction as of April 1974	0	40

Table X-2 assumes that paper and other organic waste would be incinerated and not recycled. The per capita generation of solid waste is assumed to increase from the rate of 3.6 pounds in 1973 to 4.3 pounds per capita in 1980. Population growth is assumed to be "Series E" (9.7% cumulative from 1970 to 1980). SMSA's where land fill is uneconomical or unavailable would burn solid waste to provide supplementary steam for electricity generation or other use. It was assumed that 47 SMSA's would therefore have an economic incentive to recover energy from all of their trash. These 47 cities now generate about half of the potential solid waste. Of the 47 feasible cities, about 35 were considered to be key cities where interest is high and the resource potential is great. If these 35 cities convert 100% of their carbonaceous waste into energy, they could supply the equivalent of 263 MBD of crude oil. However, institutional and technical constraints will probably delay conversion to solid waste energy recovery, and most cities will phase in new facilities slowly. Several communities have waste combustion facilities under construction which will be on line by 1977.

About 30 municipalities now have plans to operate plants which will be able to process about 36,000 tons of segregrated waste per day and which will be able to recover the energy equivalent of 40 MBD by 1980. It is expected that more new construction will be completed in the next few years so that the total energy being recovered in 1980 will be about 65 MBD.

In addition to its obvious use as an energy source, the use of solid waste as fuel offers several distinct benefits:

1. It produces low sulfur emissions
2. It reduces landfill requirements
3. The waste collection facilities are already in place and many urban power plants can be easily converted to urban waste.

C. Recycling of Materials

Many materials are in short supply due to resource and raw materials limitations. If the economics of producing raw material continues its current trend, there will be a substantial movement in the near future toward recycling of primary materials.

Midwest Research Institute made a projection in 1973 of the amount of aluminum, ferrous metals and glass which would be available for recycling. Of the total, about 70-74% was generated by SMSA's in which segregation and recovery of the materials from the total waste was feasible. Assuming that 25% of the total recoverable waste were actually recovered in 1980, the following table (Table X-3) projects the energy savings where segregation and recovery of the materials from the total waste is feasible.

Table X-3

	1980 Total MBD
Aluminum	20
Ferrous Materials	13
Glass	2
TOTAL	35

In the area of paper recycling, using recycled fiber in paper and paperboard production systems appears to require less energy than using virgin woodpulp. However, no estimates of the potential energy savings have been presented in this analysis for two reasons. First, independently developed estimates of the energy effects of paper recycling differ substantially. Until these estimates are systematically and thoroughly compared and reconciled, meaningful data are not available. Second, the more energy intensive virgin pulping operations typically derive at least part of their energy requirements from bark and other wood wastes rather than from fossil fuel sources.

In some cases, by-product energy derived from spent pulping liquors is sufficient to supply all of or more than the pulping energy requirements.

It was mentioned earlier that implementation of one energy conservation measure may reduce the benefits from another. One example of this is the effect of source reduction on the potential energy savings from recycling. Because source reduction will decrease the amount of materials available for recycling, the potential energy savings resulting from recycling will also be reduced by source reduction.

An analysis prepared by Resource Planning Associates for the Federal Energy Administration in 1974 has predicted that if Federal legislation is enacted approximately twice as much energy will be provided by resource recovery as EPA has forecast without legislation. Table X-4 summarizes the EPA and FEA reports.

Table X-4

Energy Benefits in 1980
(MBD)

	EPA Estimates	FEA (RPA)
Recycling of materials	35	70
Combustion of solid waste	65	130
	100	200

CHAPTER XI

FURTHER WORK

The previous chapters show clearly that there is a great deal of information available on the costs, economic impacts, and energy impacts of pollution control regulations. At the same time it is clear that additional analyses must be done to insure as comprehensive coverage of the impacts as possible, as well as to provide updates of the analyses already completed.

A. Economic Impacts

More research is required on economic impact for two reasons. First, although analysis used in the setting of individual standards (such as effluent guidelines for an industry) has generally tried to cover the combined impacts of all environmental regulations, often there has not been enough scrutiny given to regulations other than the one being established at that time. The most recent studies which examined the impact of all regulations on each industry are now outdated in many cases because of the promulgation of new standards. Secondly, economic conditions, including costs of control technology and profitability of the firms, have changed considerably since some of the existing studies were done; thus an updating of these analyses is needed.

Consequently, a program of eight studies has been designed for completion this fiscal year, including analysis of economic impact for the following areas:

- Macroeconomic impacts
- Total industry impacts for:
  - Steel
  - Electric utilities

  - Petroleum
  - Chemicals
  - Pulp and paper
  - Nonferrous metals
- Capital market impacts

Macroeconomic Impacts

The macroeconomic study, now underway with Chase Econometrics Associates, will be the third annual iteration of an effort to project economic impacts from pollution control requirements on the national economy. It will use costs from EPA research and from the 1974 Council of Environmental Quality (CEQ) Annual Report.

The model used includes an econometric macro-level model linked with an 185-sector national input-output model. The total model will be run for a variety of different assumptions, including:

- Three cost assumptions
  - baseline
  - 125% of baseline
  - 80% of baseline investment with 110% of baseline operating and maintenance costs (representing process changes)
- Two timing assumptions
  - peaked according to statutory requirements
  - levelled out (disregarding effective year of regulations)

- Two economic scenarios
  - Chase assumptions
  - Bureau of Labor Statistics assumptions

The output of the model will be, for various combinations of assumptions, the key national economic indicators such as those discussed in Chapter III and specific impacts by sector from the input-output model.

Specific Industry Impacts

The six industries for which the integrated impact studies are to be performed were selected because they are among the largest industrial dischargers, they are expected to have the most significant economic impacts since they account for 72% of 1973 and 1974 pollution control investment by all industries, and they are all affected by multiple environmental standards.

The studies will use as inputs the projected incremental industry costs for air, water, and solid waste disposal (EPA research, CEQ projections and BEA survey data) and the macroeconomic variables from the Chase Econometric study.

Outputs from the studies will include:

- Price effects
  - direct effects on prices in the industry
  - secondary effects on prices in other industries

- Financial effects
  - profitability
  - capital costs
  - capital availability
- Direct and secondary production effects
  - output
  - productivity
  - product mix
  - plant closings
  - industry growth
- Employment effects
- Community and regional effects
- Balance of payments effects
- Effect on investment in non-environmental assets

Using an expanded version of the impact analysis methodology employed to determine the impact of a single regulation on an industry, these six studies will show the combined impact of all environmental regulations on the subject industries. The time frame of the analysis will be 1974-1983, separating out 1983 BAT costs to show impacts both with and without these requirements. In general, the research will test the sensitivity of the industry impacts to alternative assumptions for levels and phasing of Federal regulations.

Capital Market Impact

The capital availability study will draw data from all of the industry studies, past and present, in order to examine aggregate industrial capital supply and demand. It will employ alternative scenarios of monetary policy, foreign investment and overall capital demand in the process of developing capital costs and availability. The capital constraints so developed will then be fed back into the individual industry studies for a final interation.

This study will put pollution control capital requirements into perspective relative to overall industry capital needs for other purposes, and it will examine the question of the degree to which pollution control investment will replace investment designed to maintain or increase productive capacity.

In a sense, the capital availability study serves as a link between the macroeconomic study and the individual industry impact studies. Overall, it is expected that upon completion of the scheduled further research EPA will have a more coherent assessment of the combined impact of existing and proposed Federal pollution control regulations on individual industries and on the national economy, at a level of coverage and comprensiveness not currently available.

B. Further Energy Impact Studies

EPA's continuing analysis of energy impacts is being reoriented in order to be as responsive as possible to the National Academy of Sciences study of the effects of environmenal protection programs on energy supply and demand. In particular, EPA is focusing its analysis on ways to reduce the energy impact of sulfur regulations on power-plants and on achieving mobile source emission standards. In addition, the benefits of EPA's resource recovery programs and alternative transportation control strategies deserve further analysis. These studies dovetail considerably with energy conservation analysis which is being done in conjunction with the Federal Energy Administration.

EPA has also reviewed the administration of its programs in order to ensure that energy impacts are given explicit consideration during the review process for standards and regulations and in order to ensure that municipal wastewater treatment strategies minimize energy use to the maximum feasible extent.